Vol. 2, No. 2 FEBRUARY, 1916

PERIODICAL ROOM
RECEIVED
JAN 27 1916
UNIV. OF MICH.
LIBRARY

THE SCIENTIFIC MONTHLY

EDITED BY J. McKEEN CATTELL

CONTENTS

The Avoidable Loss of Life. Dr. J. Howard Beard 105
The Causes of War. Professor I. W. Howerth 118
The Islands of the Mid-Pacific. Dr. Alfred Goldsborough Mayer . 125
Battles and Rainfall. Professor Alexander McAdie 149
The Races of Britain. Wm. H. Babcock 153
Some Phenomena of Fluid Motion and the Flight of a Baseball. Professor W. S. Franklin 174
Hunger and Food. Professor George J. Peirce 181
The Reincarnation of James Eights, Antarctic Explorer. Dr. John M. Clarke 189
The Progress of Science:
The Columbus Meeting of the American Association for the Advancement of Science; The Ohio State University; Scientific Items 203

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.

NEW YORK: Sub-Station 84

Single Numbers, 30 Cents Yearly Subscription, $3.00

Copyright, 1915, by The Science Press

JUST PUBLISHT

Smith's Commerce and Industry

By J. Russell Smith, Professor of Industry in the Wharton School of Finance and Commerce of the University of Pennsylvania.

554 pp. 12mo. $1.40.

The material of this commercial geography text-book is arranged by countries, but the subordinate arrangement under the United States is by industries. In discussing the industries of the United States the author follows them into other countries, thus giving an idea of their world-wide relations. In general, he has followed the plan of making comparisons between countries instead of confining the discussion to one locality at a time.

The usual plan of treating the physical geography of a country in a separate, formal statement, preliminary to the discussion of its industries is not followed in this book. On the contrary, the physical features are treated directly in connection with the industries themselves, thus bringing out the relations between them.

Half of the book is devoted to the United States. Of foreign countries, Latin America and the Orient receive unusual attention because of our future trade expansion with those countries.

World trade routes and certain generalizations, such as the laws of trade, are reserved for the last section because an understanding of them depends on a knowledge of the facts in the preceding sections. In this section, also, are certain interesting predictions in regard to the future development of industry. Among these are the utilization of the rocky hills of New England and the arid plains of the West by means of tree crops; the diversification of farming in the South by supply crops; the greater utilization, as coal and oil fail, of other sources of power, such as wind, water, tide, and even the sun; and the extraction of nitrogen from the air and phosphorus from the sea.

Many passages relating to the history of industry are interspersed in the text. A statistical appendix of twenty-four pages will be especially valuable to schools with limited reference libraries.

HENRY HOLT AND COMPANY

44 West 33rd Street, New York — **623 South Wabash Avenue, Chicago**

THE SCIENTIFIC MONTHLY

FEBRUARY, 1916

THE AVOIDABLE LOSS OF LIFE

By J. HOWARD BEARD, M.D.
UNIVERSITY OF ILLINOIS

AS a nation, we are moved to immediate action by the loss of a few hundred lives in a spectacular way, but the deaths of thousands of our fellow citizens from avoidable, but insidious causes do not interest us in proportion to the loss involved or stimulate us to the necessary efforts of prevention.

The burning of a theater with the loss of several hundred lives is reported as a disaster and is followed by legislation making public buildings safe, but whooping cough, which destroys annually 10,000 persons and renders 190,000 ill, is frequently not listed as a notifiable infectious disease. We are horrified at the European conflict, but the combined loss of all the navies engaged is less than the number slain each year in this country by the typhoid bacillus. In a modern battle, 100,000 men may be killed and wounded, but the tubercle bacillus slaughters 147,600 of our citizens yearly, and a million and a half remain infected, the greater number of which will die of tuberculosis.

Were we to consider, in addition to communicable disease, the unnecessary loss of life and health associated with industries involving the handling of poisonous metals; the breathing of dangerous gases; the inhaling of injurious dust; the accidents of mining, transportation, construction and negligence—in fine, the preventable deaths and sickness due to occupation and carelessness—we would have a list of dead and injured unequaled by any of the warring nations of Europe.

As it is our purpose to consider, briefly, the mortality and illness due to the more common diseases and their prevention, we shall not discuss the industrial and accidental causes of loss of life and health farther than to note that Andrews estimates, on the basis of the careful results of German experience, that we have in our midst each year, at least, 13,500,000 cases of industrial sickness. Hoffman states that there are approximately 82,530 deaths, annually, in the United States due to accidents, and that in connection with the carrying on of dangerous industries, there are 25,000 deaths and 700,000 injuries involving a disability of longer than four weeks.

It is impossible to determine accurately from the last available statistics (1913) the exact number of deaths in continental United States due to a given disease, for 65.1 per cent. of the population only is included within the registration area. We may, however, obtain the approximate number of deaths for the country by using the rates of mortality per 100,000 population in the registration area and then computing the number of deaths on a basis of 100,000,000 inhabitants, the Census Bureau estimate for April 2, 1915. Such a computation is very conservative, for it does not include failures to report deaths and it places the Registration Area and Non-Registration Area on an equality, a classification, which, if appreciation of vital statistics may be taken as a standard of the attitude of a state towards public health, certainly does not underestimate the sanitary excellence of the non-registration area. The registration area contains but few of the states having large negro populations.

Communicable Disease

Over 500,000 people die of communicable disease each year in the United States and over five millions are sick as a result of infection. Had such a loss of life and health been localized, a city the size of Cleveland would have been depopulated and every individual in two cities the size of Chicago would have been in need of medical attention.

The immediate death rate and illness of infectious disease are scarcely more important than those of their complications and sequelæ. Measles and whooping cough prepare the soil for tuberculosis; scarlet fever for renal disease; rheumatic fever, tonsillitis, pneumonia, and syphilis for cardiac failure; and, infectious disease, in general, and syphilis in particular for vascular degeneration. The effect of sequelæ are well illustrated in the recent studies of Dublin in connection with typhoid fever. He noted that the death rate among typhoid survivors for the three years following the attack was twice the expected mortality for an equal number of individuals of the same age, sex, and color. Of those dying within three years following recovery, tuberculosis caused 39 per cent. of the deaths and heart disease 14.8 per cent. Dublin estimates that 8,000 deaths occur in the United States each year among persons who have had their vitality so impaired by typhoid fever that they succumb within the first or second year after recovery.

On account of long association with measles and whooping cough, the public has come to regard their presence as to be expected and of slight consequence to either the individual or to the community. In view of the fact that they are often more severe in adults than children, many parents make little effort to prevent the exposure of their children or to protect others.

Such an attitude is unsupported by the facts, for both measles and whooping cough, when considered in connection with their complica-

tions and sequelæ, are serious diseases, especially in very young children. Twelve thousand persons die of measles in the United States annually, and ten thousand of whooping cough. 81 per cent. of the deaths due to measles and 95 per cent. of those caused by whooping cough occur in children under five years of age. Obviously, the more cases the greater the number of deaths of young children, the more numerous the instances of deafness due to measles, and the more the number of individuals left a well-prepared soil for other infections. The failure of the mortality rates of measles and whooping cough to show a reduction during the last fifteen years is due to the fact that they are highly communicable in their early stage when diagnosis is most difficult and to the attitude of the public.

While it may be difficult to influence the morbidity of these diseases, the problem of the reduction of the mortality is 95 per cent. one of preventing children from acquiring the disease until they are ten years old. If parents were so informed as to realize the seriousness of measles and whooping cough and their sequelæ, the methods for control and isolation, and the grave responsibility that rests upon the individual who causes a child to be exposed, there would be such an effort to protect young children that there would soon be a decline in the mortality rates.

Scarlet fever causes the loss of nearly nine thousand lives, 82 per cent. occurring before the tenth year of life. Scarlatina is difficult to control, as its cause is unknown and mild cases may occur which are almost impossible of detection, but which serve as a focus for further spread of the disease. It is certain, however, that many unnecessary cases of scarlet fever are due to lack of care of the attendants upon patients; the non-pasteurization of milk; the failure to give thorough disinfection; the absence of adequate medical inspection of schools; and to imperfect isolation and too short quarantine. The deaths due to the failure to use effectively the well-recognized methods of prevention could and should be avoided.

Diphtheria and croup are responsible for the death of 18,000 people annually; 88 per cent. within the first decade of life. The fatal cases of croup are usually the work of the diphtheria bacillus. The number of deaths due to diphtheria have almost uninterruptedly decreased during the last fifteen years and, at present, are less than one-half that of 1900. As striking as this decrease may be, the mortality is much too high for a disease of known etiology, of well-recognized epidemiology, and one for which we possess a specific preventive and curative therapy.

The spread of diphtheria may be by carriers, improper isolation, incomplete disinfection, contaminated articles, direct contact with patients, and the failure to require repeated cultures from the nose, as well as from the throat, before the raising of quarantine.

The mortality of diphtheria is almost entirely dependent upon the time of the administration of antitoxin. If it is given in sufficient dose within the first twenty-four hours, practically all patients will recover; if withheld beyond the first day, the death rate increases with each hour. The delay in receiving antitoxin is usually due to the slowness of the patient to obtain medical attention and the waiting on the part of the physician to determine the nature of a suspicious sore-throat clinically, rather than bacteriologically.

We may expect much greater reduction in the number of deaths from diphtheria by isolation and bacteriological examination of all suspicious sore-throats, by rigid enforcement of quarantine, by greater effort to discover and eliminate carriers, by education of the public as to the need of early obtaining medical advice and to the necessity of the quick administration of antitoxin.

In 1913, there were about 18,000 deaths from typhoid fever and approximately 180,000 cases. Happily, this is a reduction of 50 per cent. in 12 years, but the rate is still inexcusably high. Typhoid fever so impairs the vitality of the individual that his mortality is twice the expected death rate during the three years succeeding the attack and in this way, according to Dublin, is responsible indirectly for the loss of 8,000 lives annually.

Typhoid fever should be eliminated. Improvements in water supplies, scientific sewage disposal, the protection of milk, meat and vegetables from contamination, the anti-fly campaigns, and, perhaps, the adoption of typhoid inoculation have been largely instrumental in lowering the death rate from 35.9 per 100,000 population in 1900 to 17.9 in 1913.

The contact of a large number of individuals aids in the dissemination of typhoid fever, yet the death rates of our largest cities, which take precautions against the typhoid bacillus, are about one third the rate for the entire Registration Area. While certain large cities have shown great progress in the reduction of typhoid fever, the sanitation of the rural section of the country is in its infancy and in many of the smaller towns and villages, the insanitary privy and polluted well are menaces to the health of the community.

Typhoid and cholera have much in common; both are of well-known etiology, are of similar epidemiology, and both owe their prevalence to the transference of the excreta of one individual to the alimentary tract of another. They differ in that cholera is explosive in its onset, has a higher mortality, and is widely disseminated at certain times and places, while typhoid fever is almost ubiquitous, and, on account of the length of its incubation and the insidiousness of its inception, its origin may be difficult to trace.

Cholera has been rather widely spread in the United States, but

scientific methods intelligently and vigorously applied have driven it from the country and prevented it from gaining a foothold in any of our sea-coast cities by importation from abroad. Cholera with its sudden onset, its rapid spread, and high mortality is impressive, and has so stamped itself in the public mind, that the possibility of its introduction into the country is a cause for a popular demand for the exercise of every precaution against it.

Were we to adopt the same attitude towards typhoid fever, unnecessary contact with it would be avoided, no convalescent would take his place in society until a competent bacteriologist had assured him it was safe to do so, carriers would be placed under supervision, insanitary privies would be abolished, sewer connection would take the place of the cess-pool, milk would be pasteurized, food would be insured against contamination, water supplies would cease to be questionable, sewage would receive proper disposal, the fly would be exterminated, inoculation would be exceedingly popular, and typhoid fever, like cholera and yellow fever, would become a matter of history.

It is impossible to determine the extent of syphilis, a disease protean in its manifestations, variable in its intensity, chronic in its tendency, and hereditary in its scope. It may be conservatively estimated that there are at least a million and a half syphilitics in the United States. In 1913, syphilis was directly responsible for 7,200 deaths, for 6,900 due to paresis, and 2,600 caused by locomotor ataxia. It attacks the vascular system with special severity and is a great factor in the mortality due to insufficiency of the aortic valves, aneurism, arterio-sclerosis, certain groups of cases of angina pectoris, and cerebral hemorrhage. Syphilis produces over 26 per cent. of all stillbirths and holds an important place as a cause of death within the first year of life. Nearly 20 per cent. of the first entrances to the institutions for the insane are due to this disease. There is an increased mortality rate among syphilitics of 70 per cent., which means a reduction of the average expectancy of life by five and a half years.

In the presence of the ravages of this scourge of the human race, the one thing that stands out most conspicuously is the ability to prevent it. The moralist would attack the problem of syphilis by clean living, the abolition of prostitution, by instruction of the youth in regard to the danger of venereal disease and would discourage the postponement of marriage. These measures would be the happiest, the most efficient and certainly the most desirable means of prevention, but, on account of the frailty of human nature and the strength of the sexual instinct, are most difficult of general application. The sanitarian would utilize the full force of ethics, but, in addition, would urge the establishment of hospitals for the early diagnosis and prompt treatment of syphilis, would educate the public in the means of prophylaxis,

and would make it a criminal offense for one individual to knowingly transmit the disease to another.

Syphilis would be as infrequent as malaria if the public understood thoroughly the danger of venereal disease, knew the importance of early treatment both for the syphilitic and for the protection of his associates, appreciated the need of instruction in prophylaxis, and realized the necessity of the state establishing institutions for free treatment as a sanitary measure for the protection of its uninfected citizens.

The facilities for the treatment of syphilis on an extensive scale are as inadequate as necessary. Pusey has admirably described the attitude of the hospitals towards this disease.

> Most public hospitals . . . assume the unconscious attitude that the syphilitic is responsible for his own misfortune, and of all the sick, except those with other venereal diseases, is least worthy of charity; ignoring the fact that, worthy or unworthy, he is a public danger, and the greater danger the more unworthy and vicious.

Our civilization must approach the stage when all lovers of mankind will drag forth this ghastly form which for centuries has concealed itself in the shadow of prudery and let it shrivel and die in the full light of public knowledge and in the presence of a triumphant Preventive Medicine.

Pneumonia destroys annually 132,400 lives, is the most prevalent and most fatal of all the acute communicable diseases. Its occurrence has shown considerable reduction during the last thirteen years, falling from 180.5 deaths per 100,000 population in 1900 to 132.4 in 1913.

It occurs as a primary disease; as secondary to measles, scarlet fever, whooping cough, diphtheria, influenza and typhoid; at both extremes of life—causing the death of young children and enabling elderly sufferers to easily exchange a life of invalidism for a peaceful grave.

Pneumonia is caused most frequently by the pneumococcus, but it also may be due to other organisms. It was commonly believed that pneumonia was an autogenic infection, for a pneumococcus was to be found in the oral and respiratory passages of a large proportion of healthy individuals, and that the lowering of the vitality by exposure to cold, by inhalation of dust or fumes, alcoholism, injury to lung tissue, or senility so disturbed the balance between the virulence of the organism and the susceptibility of the individual as to present a favorable opportunity for development of the disease. This conception does not agree with recent observations, which seem to indicate that the disease is due to contact with patients or with healthy carriers.

The prevention of pneumonia requires isolation of the patient, disinfection of his expectoration, and the avoidance of all things which

tend to lower the vitality of the individual or to favor the spread of the disease by carriers. The increased opportunity for infection in cities owing to crowding demands the allaying of dust, and adequate ventilation of theaters, schools, cars and public buildings. Occupations requiring excessive fatigue, exposure to unsuitable temperatures, and to dust or fumes should be under the supervision of a sanitarian and so modified as not only to add to the efficiency of the worker, but to afford him an opportunity to increase his resistance to disease. The occurrence of pneumonia may be reduced, individual susceptibility decreased, and the devitalizing influence of modern life successfully overcome by proper exercise, the abundance of fresh air at night, as well as during the day, sunlight, sensible clothing, sufficient and suitable food, cold baths, enough sleep, attention to oral hygiene, and by the avoidance of exposure, excessive fatigue and alcohol.

Tuberculosis caused 147,600 deaths in 1913. The mortality rate of tuberculosis has markedly declined, falling from 326.2 per 100,000 population in 1880 to 147.6 in 1913. The decrease has been uninterrupted since 1904. There are approximately a million and a half individuals suffering from tuberculosis in the United States.

The medical profession and the public have more consistently endeavored to prevent tuberculosis than probably any other communicable disease, but, in spite of their efforts, it is of the first importance among the causes of death and is still "The Great White Plague," "the captain of the hosts of death."

Tuberculosis is the unfortunate result of the combination of the tubercle bacillus and a lowered vitality. The necropsy findings and the Von Pirquet cutaneous reaction show that few persons pass through life without being infected. The failure of more individuals to have symptoms of the disease is due to their resistance and the number of bacilli taken into the body at one time.

The prevention of tuberculosis begins at birth and is a two-fold problem—avoiding infection and increasing the resistance of the individual.

Infection may be avoided by providing sanatoria for segregation and treatment of the tuberculous, the protection of the milk supply by testing of the cattle or by pasteurization, anti-spitting regulations, proper disposal of the sputum, and education of the public. Early diagnosis is of the utmost importance, for the sooner the disease is discovered, the greater the chance for successful treatment and the earlier the opportunity for the protection of others. With proper education of the public, it will be practical to make a diagnosis of "A fertile soil for tuberculosis" before unmistakable symptoms are present and without causing the individual or his friends unnecessary distress. In a person underweight, "a little run down," a poor eater, "rather nerv-

ous" and easily fatigued, the stage is set for tuberculosis. In such an individual, the time for rest, better food, fresh air, and change of environment has arrived. The moment for rescue is before the rapids are reached, not when the passage of the precipice is inevitable.

The increase of resistance to tuberculosis is economic and sociologic. Good food, fresh air, sanitary houses and places of occupation, sufficient sleep and the avoidance of overwork and overworry, the essentials of a normal existence, are obtainable for the well-to-do, but not for the poor. Tuberculosis is an ally of want and squalor, and is becoming more and more the disease of the overcrowded, the underfed and the overworked. Until social and economic conditions make it possible for each individual to have enough sleep, abundance of clean fresh air, sanitary housing, sufficient rest and proper food for growth and energy, society may expect to reap a harvest of tuberculosis.

Infantile Diarrhea

There are 75,200 deaths, annually, due to diarrhea in children under two years of age, a mortality exceeding the sum of the deaths caused by measles, scarlet fever, whooping cough, diphtheria and typhoid fever by 6,000.

This loss of life is mainly preventable. It is due to summer heat, want of care, ignorant feeding, improper food and bad hygiene. Many of these deaths would be avoided if maternal feeding was more common. Holt has shown that the death rate of the artificially fed infant to the breast nourished is in the ratio of 32 to 1. Maternal feeding requires little effort or care; artificial feeding demands intelligence, judgment and the means for the purchase of the proper food. Artificial feeding *per se* is not to blame, but ignorant feeding, the giving of contaminated or improper food or the failure to modify the quality and quantity of clean wholesome food to meet the needs of each child.

Heat seems to bear a direct relation to the occurrence of "summer diarrhea." It affords a better opportunity for the growth of bacteria in the child's food, and for an increase of the normal flora of the intestine. It may so influence normal digestion and metabolism as to lead to the formation of toxic substances which may cause diarrhea.

Enteritis may be largely prevented by maternal feeding. The distribution of clean milk and the instruction of the mother in its modification to meet the special needs of her child, will do much to reduce the incidence of diarrhea. Strict attention should be given to the cleanliness of the nursing bottles, nipples, and to the hygiene of the baby. The clothing of the child should be determined by the temperature rather than by tradition. Congested living quarters should be avoided and the infant should be kept out of doors as much as possible. The months of July and August should be spent in the country; if this is not feasible, the child should have the full benefit of the parks.

The Degenerative Diseases

Deaths due to lesions of the heart, kidneys and blood vessels, the diseases of old age, are on the increase. They are becoming more frequent before fifty and many individuals are dying prematurely, at an age when, as a result of training and experience, they should be most productive and of the greatest value to society.

In 1913, there were over three hundred thousand deaths due to diseases of the kidneys, heart and blood vessels. 24.2 per cent. of all the deaths due to Bright's disease and 21 per cent. of those caused by organic heart trouble occurred in individuals under fifty years of age. Cerebral hemorrhage and arteriosclerosis have increased during the last ten years.

The strenuousness of modern life, the intemperance of food and drink, exposure and the intoxications of occupation play a part in the production of renal, cardiac and vascular degeneration. In many cases, however, we see the hand of syphilis, the sequel of rheumatic fever, tonsillitis, chorea, and of pneumonia, or the probable latent injuries of scarlet fever, diphtheria, typhoid, or malaria.

In the acute cases of kidney, heart, or vascular disease, the virulence of the invading organism, the reduction of the resistance of the individual, or both, so favor the spread of the infection that signs of disease are early apparent. In the chronic cases, the injuries may be comparatively latent, the symptoms slight or absent, yet the organs may be so damaged that under the stress of modern life their period of activity may fall short ten or twenty years.

It matters little whether the premature deaths of the individuals, at a time when they are most useful, is due to infectious disease, the poisoning of occupation, the wear and tear of existence, overwork, or to the excess of food or drink, the power of prevention rests largely with the individual and the state.

On the basis of the last statistics, there are 78,900 deaths due to cancer annually in the United States. The mortality rate has steadily increased from 63 per 100,000 population in 1900 to 78.9 in 1913. Do these figures represent an actual increase? Statisticians and notably Hoffman believe that the mortality rates, "unconditionally confirm the conclusion that cancer is relatively on the increase throughout the civilized world and the increase is affecting practically all important organs and parts of the body." Physicians and surgeons are somewhat skeptical and are inclined to attribute the increase largely to better methods of diagnosis of internal cancer and to the lengthening of the average life which increases the number of individuals reaching the cancerous age.

The etiology of cancer is unknown. It is a "disease of theories" and

each theory has some evidence to support it, but which is inadequate to establish it to the exclusion of others.

The two great predisposing causes of cancer are age and irritation. Cancer usually occurs after forty, but it may not uncommonly appear earlier in life. Any source of irritation, be it mechanical, as the effect of a jagged tooth on the cheek or tongue; actinic, as the action of the Röntgen or ultra-violet rays upon the skin; thermic, as the effect of a hot pipe stem upon the tongue or lip; or chemic, as the action of arsenic and anilin dyes upon the skin, predisposes to cancer.

The prevention of cancer depends upon the education of the public as to the dangers of chronic irritation, as to the importance of the early symptoms and the necessity of an early operation. It should be universally known that any lump in the breast or unusual bleeding from the uterus in a woman above thirty-five requires investigation to exclude cancer. Sores, warts, and swellings of the lips or tongue in an individual over forty should be brought immediately to the surgeon for diagnosis. Bleeding from the bowels of a person of similar age demands the exclusion of cancer. Warts or moles that begin to show signs of growth or soreness should be removed at once. Suspicious growths should be given expert microscopical examination. All the precautions used against external precancerous lesions should be taken to avoid and discover beginning internal cancer. The best way to make a curable cancer hopeless, is to delay operation or to use plasters and salves.

Economic Importance of Preventable Disease

Society is demanding each year greater skill and increased efficiency of its members, a requirement that calls for a larger investment in the training of the individual and a condition that makes the economic loss due to preventable disease most appalling. So many factors contribute to this waste that it is practically impossible to state it in figures.

Nine tenths of all children dying of measles, whooping cough, scarlet fever and diphtheria, and all those dying of diarrhea or any diseases before the tenth year represent a total loss, for economic values have been created and destroyed without giving return.

The toll of syphilis, typhoid fever and tuberculosis is heaviest during the period of greatest usefulness. The ravages of syphilis are large between thirty and forty-five, but greatest between forty-five and sixty. It shortens the expectancy of life by 5.5 years; it renders the individual inefficient during the most productive period of life; it fastens itself upon the posterity of its victim, increasing degeneracy, encouraging poverty and promoting public charges; it erects about 20 per cent. of our insane asylums and taxes the nation for their maintenance. Typhoid fever causes 94 per cent. of its mortality before the sixtieth year, over 48 per cent. before the twenty-fifth year, and about 29 per cent.

between the fifteenth and twenty-fifth year. Tuberculosis destroys 90 per cent. of its victims before sixty, 30 per cent. before twenty-five, and 19 per cent. between the fifteenth and twenty-fifth year. Tuberculosis and typhoid fever not only strike down over 90 per cent. of those attacked before sixty, but they cause tens of thousands to seek public charity or to spend large sums to recover their health, when they should be producing. Nearly one third of the deaths due to typhoid and one fifth of those caused by tuberculosis occur in the high-school-university period of life, the time representing the maximum investment of society in the preparation of the individual for usefulness.

Diseases of the heart, kidney and blood vessels are becoming more frequent, thus individuals are prematurely lost to society who by training and experience should be of the greatest value.

The great economic loss due to the deaths of individuals before they have become an earning power and of persons dying during the most productive period of life is relatively small as compared with the enormous loss caused by illness with its consequent loss of time of the wage earner, the inefficiency of the worker, the expenditures for medicine and attention and the absence or decrease of productiveness on the part of other individuals who must spend a part or their entire time in caring for the sick.

It is obvious that this large loss of life and health constitutes a serious curtailment of the productive efficiency of the nation and that a heavy economic burden results from the support of invalids, defectives and those deprived of their bread winners. As long as preventable diseases are present, we are paying large premiums to keep them, for it would be much cheaper to prevent, than to have them.

Prophylaxis

Preventable disease is associated inseparably with poverty and ignorance, and any successful attempt at prevention must be an attack upon these twin brothers of human misery.

Poverty may be the great predisposing cause of disease or the result of it. Poverty by underfeeding, overworking and poorly housing renders the individual more susceptible to disease; by overcrowding presents a favorable opportunity for the spread of infection. The English Royal Commission on Poverty states that 55–60 per cent. of the poverty of Great Britain is due to sickness. The report of the Charity Organization of New York City seems to confirm the figures of the Commission.

The poverty-stricken individual is a fourfold menace to the nation—a poor progenitor, an inefficient producer, a potential source of disease, and frequently a malcontent. Society should realize that every individual who makes his best efforts and every child born to the nation must

be guaranteed as their inalienable rights sufficient food for growth and energy, the necessary amount of sleep and rest, abundance of fresh air, sanitary quarters, and an opportunity for an education. A different attitude fails to promote the general welfare, procreates weaklings, invites disease and undermines the stability of the nation.

Ignorance can be removed only by education, and if the intelligent individuals of every community who realize the serious importance of disease to the nation, are to be interested and increased in numbers until they will demand preventive machinery commensurate with scientific knowledge and the enactment of laws founded upon the present development of preventive medicine, public education must be pushed with greater vigor.

Much has been accomplished by popular literature, lectures and demonstrations, more will be done by them in the future, but the importance of preventable disease upon the social and economic conditions of the nation demands more than an occasional public lecture, pamphlets at infrequent intervals or casual demonstrations. Instruction in the methods of preventing disease should be an essential part of our system of education and no individual should have completed his education without the knowledge of how communicable diseases are spread and prevented; the dangers of and the methods of avoiding industrial disease; how to care for an infant; and a practical understanding of sanitation and hygiene. A system of education that requires large sums of money to teach individuals English and science and does not instruct them how to protect themselves from preventable death and illness, fails to insure its investment and may be criticized as incomplete.

Each county should have a full-time health officer and community nurses to meet the needs of the population. Their duties should be threefold: the control of disease, the education of the public, and as expert consultants for the citizens of the county upon matters of hygiene and sanitation.

With such a force it would be possible to make a sanitary survey of each industrial plant, place of amusement, summer resort and residence. Such a survey would reach a large number of persons who are not likely to hear public lectures or to read popular literature. A visit and a tactful conference of the health officer and property owner have not only a sanitary and educational value, but they create a sympathetic understanding between the citizen and the sanitarian, a condition essential to the practical progress of sanitary science.

Every large industrial plant should carefully supervise the physical condition of its employees, for the health of the workman determines his daily efficiency and the period of his productivity. Periodic physical examination of all employees would detect disease in its incipiency;

would contribute largely to community health; and would make it possible to adapt the work to the physical condition of the worker. There would be an economic gain to the employer by the reduction of the number of accidents to workmen, material and machinery; in protection against unjust claims for compensation; in the increased efficiency of the worker; and in the decreased loss of time from preventable sickness.

The prevention of disease is the function of science and society. Science must provide the way; society must use the means and bear the cost. The acceptance by society of Jenner's demonstration of the advantage of vaccination ended the devastation of smallpox; with the practical application of the discoveries of Laveran and Ross, malaria ceased to be the scourge of mankind; the use of the knowledge of Reed, Carroll and Lazear made the Panama Canal a possibility and closed our ports to yellow fever; our understanding of the life history of the Koch vibrio has kept Asiatic cholera beyond our shores; and a scientific attack upon plague has prevented its spread and practically driven it from the country.

The knowledge of tuberculosis is as complete as that of plague; the epidemiology of typhoid fever and cholera are practically identical; the understanding of syphilis is as clear as that of malaria; and the information concerning diphtheria as definite as that of yellow fever. The way for the great reduction or elimination of preventable disease is known; the need is for society to educate its members, use the methods, and bear the cost.

THE CAUSES OF WAR

By Professor I. W. HOWERTH
UNIVERSITY OF CALIFORNIA

A SUPERFICIAL consideration of the many wars of the past might lead one to think that the causes of war are as numerous as the wars themselves. There are interesting accounts of wars having been occasioned by trivial causes. A dispute over a pig is said to have threatened war at one time between the United States and Great Britain; at another time, between France and the then republic of Texas.[1] The war of 1738 between England and Spain, which later became a part of the great war of the Austrian Succession, is known in history as "Jenkin's Ear War," the actual occasion being the maltreatment by the Spaniards of an old English sea captain, resulting in the loss of an ear.[2]

If we distinguish, however, between cause and occasion, we find that, while the occasions of war are many and varied, the causes are few. This fact has been pointed out by Lecky with respect to the wars of Europe. He says:

> If, indeed, we examine only the proximate causes of European wars, they present the aspect of a perfect chaos, and the immense majority might be ascribed to isolated causes or to passing ebullitions of national jealousy. But if we examine more closely, we find that a deep-seated aversion produced by general causes had preceded and prepared the explosion. The great majority of wars during the last 1,000 years may be classified under three heads—wars produced by opposition of religious belief, wars resulting from erroneous economical notions, either concerning the balance of trade or the material advantages of conquest, and wars resulting from the collision of the two hostile doctrines of the divine right of kings and the rights of nations."[3]

Thus, according to Lecky, the causes of the wars of Europe may be reduced to three categories, namely: religious, economic and political. If, as the exponents of the doctrine of the economic interpretation of history maintain, both religious and political beliefs have an economic basis, these three sets of causes may be reduced to one, the economic. But whether history is to be thus explained or not, it is safe to say that the principal cause of the wars of Europe has been economic.

In the wars of primitive times the economic cause stands out conspicuously. Men lived in tribal groups; they were unacquainted with efficient modes of production; they were averse to labor. Savage tribes,

[1] See Macy, A. W., "Curious Bits of History," p. 160, and Wooten, Dudley G., "A Comprehensive History of Texas," Vol. 1, page 370.

[2] Cheyney, Edward T., "Short History of England," page 557.

[3] Rationalism in Europe, Vol. II., pp. 219–20.

rapidly expanding, naturally experienced increasing difficulty in obtaining a food supply. This led to nomadic habits or to migration. Roving bands, pastoral or hunting, in search of food, came into collision. The result was war, followed in primitive times by cannibalism, later by general exploitation and slavery. Says Robinson:

> Among tribes subsisting on the products furnished spontaneously by nature war is the normal condition. The reason is, in the main, economic. The scarcity and precariousness of the food supply render much land necessary to support each family. Unless climatic conditions absolutely prevent an increase of population, the hunting grounds of the several tribes are of necessity extended until they overlap; and so arises a war of extermination, whose issue is the destruction of the least efficient social organization and the restoration of the equilibrium between population and the food supply.[4]

The tribal wars of the American Indians may be taken as an illustration. The Algonquin and Iroquois tribes met and fought in the fine hunting grounds of the Mohawk valley; the Shawnees, Delawares, and Miamis, in Kentucky, "the dark and bloody ground."

So also the economic cause is plainly visible in the early wars of history, whether they took place in Europe or in Asia. In the earlier civilizations there was periodically a swarming of the hive, as one might say, great migrations, *Völkerwanderungen,* which necessarily meant contact with other civilizations and the resulting contest for food, wealth and the other material things that men most desire. The very nature of these early wars is indicative of the fact that they were due primarily to an economic cause.

The same thing is true, although less conspicuously so, of the later wars of history. It was so of the early wars of Greece and Rome, of the wars of feudal times, of the series of contests between the various maritime powers, of the wars of the Palatinate, of the war of the Spanish Succession, and of the American Revolution. Even the so-called religious wars are reduceable to an economic basis—the crusades, for example. Says Molinari:

> Lorsque l'expérience eut démontré que les croisades ne payaient pas on y renonca et les guerres d'expansion des peuples de l'Europe ne recommencèrent qu'après la découverte de l'Amerique.[5]

The wars of Napoleon, and many of those since his overthrow, as, for instance, the Crimean war, the Chinese wars, the Mexican war and our own great Rebellion, have been largely if not chiefly due to economic questions, either with respect to the acquisition of trade or of trade routes. The same may be said of the present war in Europe. If we penetrate beneath the superficial phenomena—the assassination of a crown prince, mobilization of armies, royal ambitions, national jealousies

[4] *Political Science Quarterly,* Vol. XV., No. 4 (Dec., 1900), p. 582.

[5] "Grandeur et decadence de la guerre," p. 49. Quoted by Robertson in the article cited.

and race prejudices—we find commercial rivalries, desires for an outlet to the sea, or "a place in the sun."

Wars in general, then, arise chiefly from economic conditions. In early times the principal motive was either conquest and the advantages arising therefrom or the securing or maintenance of some special economic advantage. Since the development of a money economy, and the consequent national interdependence, the possibilities of economic exploitation through conquest have gradually diminished, so that the idea that war is economically profitable to any of the countries concerned may well be regarded to-day as "The Great Illusion." Still, economic friction between the trading nations of the world is a patent fact, and it is to-day, as it has been in the past, the principal cause of international strife.

Other causes, of course, have occasionally risen into prominence, particularly the ambition of rulers; the desire of governing classes to aggrandize or protect themselves; national bumptiousness and aggressiveness, due chiefly to an ignorant and blind patriotism; and, as a minor cause, differences in philosophic tenets with respect to government. And so also the sentiment of nationality, considerations of national honor, the preservation of the wellsprings of national morality, which most people seem to think gush forth only in their own country; the attainment or the preservation of "the peace of righteousness"—which means, I suppose, the peace resulting from the victory of "our side" in a contest—all these, even if they have not occasioned war, have been paraded among the reasons that are marshalled by those who would justify war or even glorify it. But, after all is said, the fact remains that the causes of war have been and are to-day chiefly economic.

This being the case, it will be interesting now, and necessary to the general purpose of this discussion, to turn our attention to the nature of an economic cause.

The idea of cause is inseparable from the idea of force. Some kind of force is indeed the only efficient cause, whether it be in the physical, vital or social world. Now the forces which produce social results are the feelings. Feeling is the dynamic element in human society. Social conflicts, of which war is an example, can arise only from a conflict of feeling between the groups involved. If this conflict is due to a clash of economic interests we have, in the initiation of such conflict, the operation and manifestation of an economic cause. An economic cause, then, is mutual hostility of feeling arising from the competition of industrial groups of different classes or nations. To say, then, that the chief cause of war is economic is but to say that wars are due in general to industrial competition as carried on between the nations of the world.

But the industrial régime of the world has always been, and is now,

competitive. Nations are in constant competition for markets, for trade routes, for opportunities for expansion, or, more accurately, the trading classes of nations are in such competition. Some gain, others lose. Naturally, hostile feelings are evoked, government is appealed to, international disputes arise, and, becoming acute, wars are declared and are waged to promote the economic interests of the dominant industrial classes. The chief conditions that incite war, then, are inherent in our present system of industry. Indeed, the business of the world as carried on to-day is war, only it is veiled by certain conventions, too often by pretense and hypocrisy, and is transacted in general under the sanction of law. When the pressure becomes too strong upon the feelings, that is, when the conventional and peaceful means are insufficient to obtain the end sought, there is resort to arms. Armed warfare is only a phase of the general industrial warfare that prevails the world over.

Some deny this fact. They persuade themselves, or are persuaded by the biased arguments of those interested in maintaining things as they are, that the interests of the various industrial and commercial classes and nations are the same. But this is not the case. As Robinson well says, in the article already quoted,

> The dogma of the natural and necessary harmony of the interests of all nations is just as false as that of their natural and necessary antagonism. This dogma is true only so long as each nation has a natural monopoly in some one line of industry,—as the free traders erroneously assumed that England had in manufacturing. While competition is absent, commerce is, indeed, a bond of peace and good will between those who buy and those who sell in return. But the moment that two nations embark extensively in the same line of industry, that moment commerce becomes a sword, dividing and setting at enmity those who are rivals for the same markets. For of them it is true, as Montaigne declared, that no profit can be made except to the damage of another. The increase of one is the decrease of the other; the prosperity of one is the other's destruction. Such nations stand to each other as two Indian tribes when there is but game enough for one.[6]

Now the bearing of all this upon the immediate or early cessation of war is obvious. Wars are not likely to cease so long as the fundamental cause is operative, that is to say, so long as economic conditions and relationships remain as they are now. These conditions and relationships will continue to evoke strife, and, under the stress of passion, swords will be drawn no matter how unprofitable from a business standpoint war may be. This is not to assert that human weakness is the cause of war. It is the weight pressing upon the beam, not the weakness of the material, that causes the fracture. So war is due, not primarily to human weakness, but to the economic conditions in which this weakness is unable to bear the strain. There is no hope of permanent peace without a change in the conditions which make strife inevitable.

[6] Article cited.

The fact that commerce and business in general do in some respects make for peace has led many to suppose that the spread of commerce is fatal to the existence of war. Professor Shaler, writing in 1896, said:

> So long as the control of governments was in the uneconomic classes of men who had nothing to lose and much to gain by war, the influences were overwhelming for its continuance; now that the business people are gaining control of the world's affairs there is reason to hope that the cure is about to come to this ancient and enduring ill.[7]

But this hope is vain, as recent events have shown. So long as the economic interests of classes and nations are antagonistic there will be war. No demonstrations of its waste, no sentimental appeals for peace, will prevent it. Not the spread of commerce but the harmonization of economic interests is the most effective remedy.

The application of this remedy is conceivable, however impossible such application may be at the present time. A cause of war arising from economic conditions is not ineradicable. War is not due to anything inherent in nature or in man—not to hunger and the law of decreasing returns, as Robinson concludes. He says:

> The cause of war is as permanent as hunger itself; since both spring from the same source, the law of decreasing returns. So long as that persists, war must remain, in the last analysis, a national business undertaking, designed to procure or preserve foreign markets, that is, the means of continued growth and prosperity. *Chacun doit grandir ou mourir.*[8]

But hunger and the law of decreasing returns might conceivably lead, and ought to lead, to cooperative effort to produce food, rather than to war, which is an organized and systematic effort to secure it by robbery, and in which much of it is unprofitably consumed and destroyed. Might it not have been said in the earlier swashbuckler days, and with equal truth, or error, that "the cause of piracy and robbery is as permanent as hunger itself"; and yet "lifting" the goods of another, as a means of "growth and prosperity," has in general given way to other and more approved methods of gaining a livelihood. May it not be also that in time an improved industrial economy will provide a sufficient amount of material goods to maintain an intelligently restricted population? With the enormous possibilities of industry, intelligently organized and intelligently directed, the expectation that the maintenance of a nation's civilization by work rather than by war may at last be realized, and thus the economic cause of war be removed at all events, this expectation should not be regarded as an altogether empty and iridescent dream.

But granting the present impossibility of eliminating the economic cause of war by a revolutionary change in economic conditions, there remains the hope that through the dissemination of knowledge respecting the waste and futility of war as a mode of social action, and as a means of achieving social results, at least the frequency of war may be

[7] Shaler, N. S., *North American Review*, Vol. 162, page 340.

[8] Article cited.

lessened. Popular education, however, it must be admitted, has not fulfilled the early expectations with respect to its promotion of peace. It has indeed lamentably failed; for the results of increased popular intelligence and the advancement of science are manifested in the greater destructiveness of war, and apparently in its more savage brutality. The failure, however, ought not to be charged to education itself, but to the kind of education that has prevailed and to the dissemination of erroneous ideas concerning the nature and results of war—the ideas of Treitschke and Bernhardi, false conceptions of national honor and patriotism, and the pernicious idea that the best way to prevent war is constantly to think about it and prepare for it, an idea contradicted by all we know of human psychology with respect to the relation of thought to action. Education properly conceived as the distribution of scientific knowledge and the development of the social spirit would in time eliminate war and all the other remediable evils that afflict mankind. It is the sole panacea. But as a means of preventing war it needs to be reformed. And to begin with there should be scientific instruction with respect to the nature of war, rather than the inculcation of false ideas which tend to promote it.

The true nature of war, unlike its causes, is not obscure. It is plainly revealed by a knowledge of biological and social evolution. Such knowledge ought to lead to recognition of the distinction between the blind social evolution of nature, effected partly by war, and a possible ordered social evolution achieved by human foresight. But the study of evolution, the one study capable of rendering this great service, has been discouraged, sometimes forbidden, in our schools and colleges, on the ground of its being unorthodox or atheistic; hence the superstition of nature worship which prevails to-day. There is indeed a natural evolution of nations and societies. As Spencer says:

> It is true that much social evolution is achieved without any intention on the part of citizens to achieve it, and even without the consciousness that they are achieving it.[9]

But such evolution is uncertain, slow, wasteful and to no end save the adjustment of the social organism to its environment. It does not result in the survival of the best, but the fittest, and sometimes the fittest is ethically the worst. Its chief method is competition or war, both being essentially the same. This method, like all the methods of nature, is direct; it is the method of the brute. Says Professor Ward:

> War, however much the indirect method may be incidentally employed in its detailed management, is in its *ensemble* essentially a measure of direct coercion. The effects are no greater than the effort required to secure them. The action is exactly balanced by the reaction. The algebraic sum of the results of all wars is *nil*.[10]

[9] Spencer Herbert, "Various Fragments," page 132.
[10] Ward, L. F., "Glimpses of the Cosmos," III., 41.

It is the function of intelligence to supplant the direct method of evolution as manifested by war by the indirect method of foresight and control. Man is man only in proportion as he controls natural phenomena and supplants the method of nature by the method of mind.

The world ought not to await the complete work of education, however, before putting an end to war. Only a preponderance of intelligent opinion with respect to war is necessary, and the effective expression of this opinion through an organization that will restrain the rashly belligerent nation from running amuck. In other words, the world must organize to prevent war, by soft words if possible, but by the use of the "big stick" if necessary. Intelligent and law-abiding men did not wait for the conversion of all duelists to abolish dueling. When they felt the power to abolish it they did so. Said St. Louis, King of France:

> We forbid, to all persons throughout our dominions, the trial by battle... and instead of battles we establish proofs by witnesses . . . and these battles we abolish in our dominions forever.[11]

So the peace movement should be directed toward the formation of a league strong enough to forbid war and that would establish, instead of war, "proofs by witnesses." War is not only an evil, it is a nuisance, and the nation inclined to belligerency should be confronted by the notice, posted by the intelligent and law-abiding people of the world, "Commit no nuisance, under penalty of the law!"

[11] Guizot, "Histoire de la Civilization en France," LeCon 14, Vol. IV., pp. 162–4.

THE ISLANDS OF THE MID-PACIFIC

By Dr. ALFRED GOLDSBOROUGH MAYER

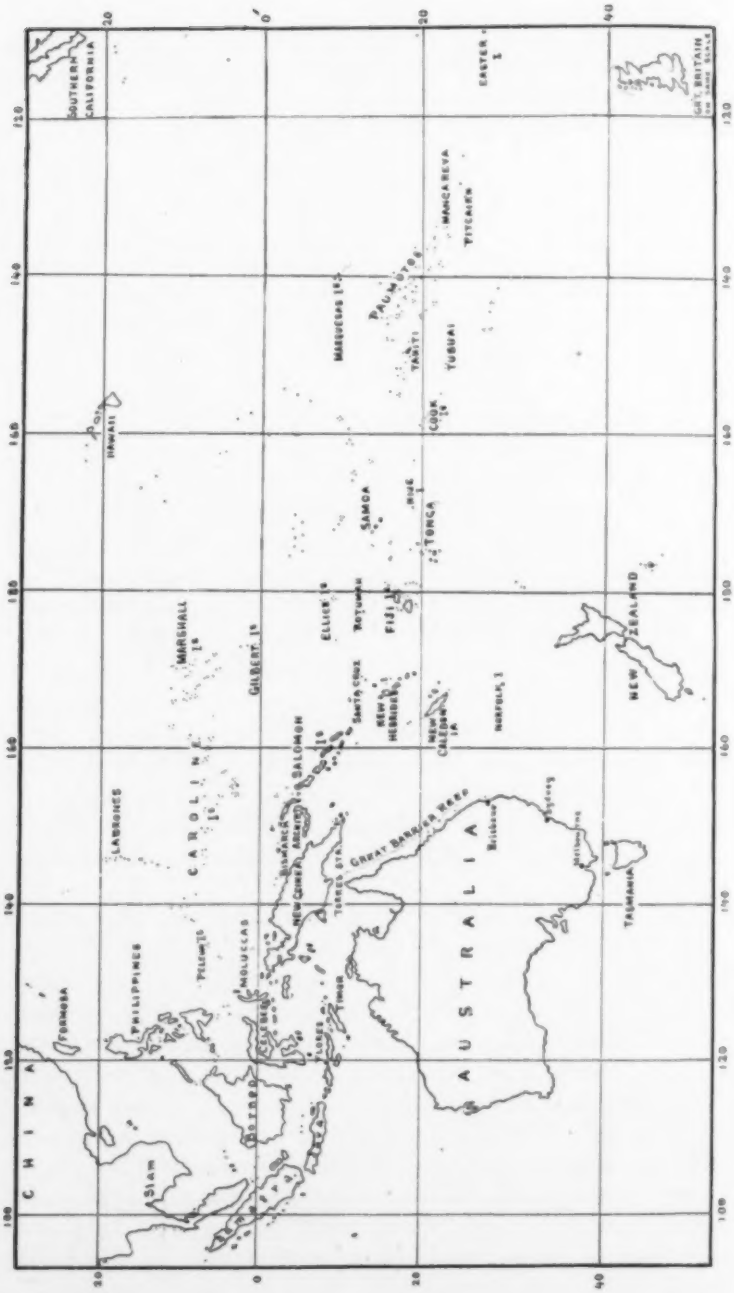
THE map of the mid-Pacific shows about eight hundred small islands dotting the expanse of the tropical sea. So prominent do these appear upon the chart with their names stretching over hundreds of miles that the voyager is surprised to find that they are in reality all but lost upon the vast area of the waters. Thus it was that in 1521 Magellan sailed 8,000 miles across the ocean and saw only four small uninhabited islets until he came upon the Ladrones in the far eastern Pacific.

During the century that elapsed after Magellan's voyage, only two important mid-Pacific groups, the Marquesas and the Paumotos, were discovered, for the explorers made the best speed they could with the southeast trade wind from the coast of South America, and such a course even from Cape Horn carries one to the northward of the great archipelagoes which lie in the tropical regions of the southern hemisphere.

Yet in the Pacific even in these days of steam, there stretches for days and weeks around one only the monotony of sea and sky, and it is with the delight of surprise that the far mountain peak is seen looming cloud-like through the haze, or, if the island be an atoll, a ragged row of cocoanut palms thrusts suddenly above the long line of the horizon.

Apart from such large land masses as New Caledonia and New Zealand, which contain continental rocks, the islands of the mid-tropical Pacific are either volcanoes, or elevated limestone reefs, or low-lying atolls which are believed to rest upon the submerged peaks of extinct volcanoes.

Sir John Murray tells us that the area of the Pacific is about 69,000,000 square miles, 65 per cent. of which is between 12,000 and 18,000 feet in depth. Indeed, the floor of the ocean between the Galapagos and the Paumotos is a plain in comparison with which the wide levels of Russia and of our Middle States are diversity itself. This vast flat bottom of the eastern Pacific is the widest area of deep water upon earth. Asia, Africa, and North and South America might all be sunken beneath it and not overlap. Indeed, one might sail nearly 8,000 miles southeastward from Behring Strait to the Antarctic, and for 7,000 miles of the course the least depth would be 12,000 feet, and at no place would the bottom be within a mile of the surface. The continental shores rise abruptly from this deep, floor, and in a few places we find trough-like or pit-like depressions sunken far below the bed of the sea, or an isolated volcanic cone rises dome-like from the plain, but the diversified



ISLANDS OF THE PACIFIC.

landscape of hill and valley has no counterpart in the hidden world beneath the sea.

The deepest regions of the oceans are commonly close to the shore and are believed to have been caused by the crumpling inward of the earth's crust due to the pressure of the near land. Such is the "Tuscarora Deep," a long narrow trough which extends northward from Japan along the coast of Asia; its bottom being more than 27,600 feet below the surface of the sea and 12,600 feet below the general level of the ocean's floor. An even more profound abyss is the Aldrich Deep close to the Tongan and Kermadec Islands which sinks to a depth of 30,930 feet. The greatest yet found, however, is the Swire Deep off Mindanao of the Philippines, this being 32,089 feet or 3,089 feet deeper than Mount Everest of the Himalayas is high.

However, one gains an idea of the rarity of such abyssal regions from the fact that of the 9,750 soundings that have been made and reported in water over 1,000 fathoms in depth, only 17 were greater than 4,000 and only 3 exceeded 5,000 fathoms in depth. The greatest recorded depth of the ocean is only 409 feet more than six miles.

By contrast with these troughs and pits, submerged plateaus rise gently above the general level of the ocean floor, and here and there and at rare intervals a mountain obtrudes above the submarine plain. All these isolated mountains are volcanoes and thus every truly oceanic island is but the summit of a pyramid thrown upward until its corroding peak may rise 13,800 feet above the sea as does Mauna Kea in Hawaii, or if now submerged, it may be capped by a thickness of several hundred feet of limestone and coral as in Bermuda.

The fairest islands in all the tropic world are those of Marquesas and Tahiti, where jagged sheets of basalt tower in grotesquely sculptured precipices thousands of feet above the soft lavas and tufas that the rains have washed away. Long ago these islands were volcanoes of an explosive type such as Ætna of to-day, and molten basalt welled upward from the depths and filled the gaping rents in the pyramids of softer ash and lava. Then, after the fires had died, the tropical rains began their slow persistent work so that to-day deep valleys wind sinuously downward from the summits to the sea, and the sound of rushing brooks is forever upon the ear. Green as corroding malachite set in the azure of the sea, the splendid peaks and shaded gorges lie mantled in the soft mist-loving verdure of the tropics, where the banana, orange, breadfruit, mango, kavika, alligator pear, and Tahitian chestnut grow in wild profusion.

The surf in these tropical regions is far less destructive than along our own frost-ravaged shores, for this is the domain of coral reefs, and many a crumbling volcanic cone lies protected within an encircling break water upon which the wave is smothered into foam, leaving only ripples to reach the palm-fringed shore.

TAE-O-HAE VALLEY, NUKUHIVA ISLAND, MARQUESAS.

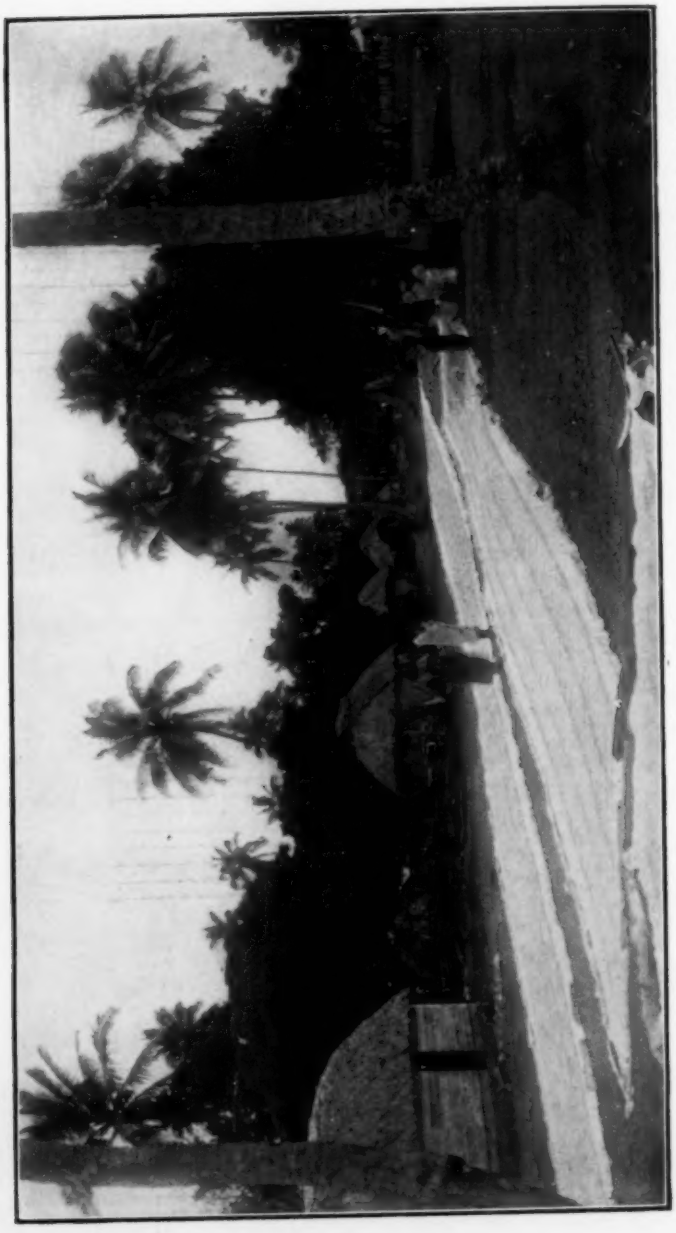
Sheltered thus from the wear of the sea, lies the slumbering volcano whose fires have been dead for many a thousand years. At night, the cool air of its mountain heights wafts downward to the sea, fragrant with jessmine and spice, and all the subtle perfume of a tropic wild. By day the sea-breeze assumes the mastery, and awakens the snowy flash of breakers where the rollers die into wavelets a mile or more from shore. This silvery line of surf marks the position of the barrier reef which encircles the island, leaving a calm and shallow channel between the reef-rim and the shore. Here protected the native plies his frail canoe, knowing as he does all the haunts of the fish among the coral clusters which here and there rise abruptly from the depths to the surface; and on calm days we may wade along the outer edge over many a place where a single seaward step would plunge one into water a hundred feet in depth.

Rich coral reefs usually occur in inaccessible places and are so studiously shunned by commercial vessels that the ordinary traveler has but little opportunity of seeing them at close range. The living corals rise in clusters above the volcanic rock or limestone upon which they have acquired an anchorage. They are, as is well known, animals closely related to sea-anemones, and their young when as small as a pin's head, are cast out into the water as little pear-shaped larvæ covered with vibrating cilia. After being drifted by currents and swimming feebly for a few days, the little creature settles down upon the bottom and soon grows

into a minute sea-anemone-like animal whose skin secretes lime and thus forms a skeleton, and it is this stony support, after the animal itself has died, that we commonly call "coral." After it has become attached to the bottom, the little polyp acquires tentacles which surround the mouth and then it begins to grow either into a simple form, or by budding to assume a shape in accordance with the habit of its species. At first but a single polyp it buds or divides so that there may be thousands of such with their stomachs more or less connected. Thus the animal is a colonial one, and when one polyp captures a minute crustacean, the other polyps in its neighborhood share in the benefit. Doctor T. Wayland Vaughan, who has studied them most carefully, tells us that corals are voracious creatures and feed upon almost any small floating animal they can capture, but plants they will have none of for they are strictly carnivorous.

Olive and yellow-greens, mauve and purple-browns are the colors of the living corals. Glinting they lie in the limpid water with the glistening white of limestone sands around them. Here and there accentuating the color of the scene is a deep blue starfish (*Linckia*), or a flower-like sea-anemone a foot or more in width beautifying a crevice with tracery rivaling old Venetian glass, while closely wedged within its special cavern lies the giant clam (*Tridacna*), the sinuous cleft between its valves, a zigzag of malachite and blue, green or mottled brown. Among the corals, one finds delicate forests of fused branches rich purple-brown with pink and snowy tips (*Acropora*), or green-olive and yellow-green nodular forms such as *Porites*, *Orbicella*, or *Goniastrea*. Some of

CANOES AND WARRIOR OF UOLA ISLAND, TRUK GROUP, CAROLINE ISLANDS.



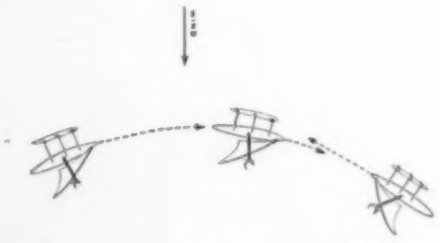
SHEETS OF TAPA BEING BLEACHED AND PRINTED IN ANTICIPATION OF THE WEDDING OF A CHIEF. Tongatabu Island, Tonga.

the species of *Porites* upon the Great Barrier Reef of Australia are twenty or more feet in diameter and must surely have been a century in growing, for it is known that in Torres Straits under favorable conditions they may enlarge in diameter at the rate of nearly two inches per annum.

Silt and drifted mud are fatal to corals, for they stifle the feeding polyps and the dead surface is soon honeycombed by a host of worms and weeds and mollusks, so that the base of each old coral-head is cavernated with intricate retreats which form the home of the reef fish—those living jewels of the tropical sea, rivalling the butterflies in color.

Opposite the mouth of every mountain stream, we find an opening in the wall of the encircling reef; for the outflow of brackish water and silt prevent the growth of corals in such places and thus a harbor is formed. Here nestled under the shadows of palm trees close to the protected shore lie the thatched houses of the natives, resembling haystacks as one sees them from afar.

Drawn up in an irregular line, for all is hap-hazard in the South Seas, lie the canoes of the village, carved in strange symbolism to propitiate gods and tribal heroes. Each has its slender outrigger ingeniously constructed, a marvel of flexibility and strength, and its sail woven of pandanus leaves is carefully covered under a matting to protect it from the molding due to damp. In sailing, the outrigger is always on the windward side, and the sail itself is never reefed, but instead one, two or three men place themselves upon the outrigger. Breezes are known therefore as "one," "two," or "three-man winds." A high degree of skill is required in sailing these canoes, for the outrigger must skim lightly through the water. Should it rise into the air, the canoe over-



MODE OF TACKING AN OUTRIGGER CANOE.

turns, and if it sinks, a sudden luff capsizes the navigators; not, however, a serious accident where all are swimmers from earliest childhood. As the outrigger must always remain upon the weather side the method of tacking is curious, for instead of luffing up into the wind, they put the helm up and hold the canoe off until the wind is abaft. Then the "tack" or lower point of the lateen sail is carried aft and tied down; and the canoe starts backward, that which was the stern now becoming the bow.

HOUSE AT EUA ISLAND, TONGA, showing a wooden drum and drumstick in the foreground.

Such is the life of man upon the "high islands" of the tropical Pacific, and as for the islands themselves, the fascination of their isolation is the keynote of their charm, set as they are in the amethystine blue of the coral sea that flashes into emerald over shallows near the shore.

THE COUNCIL HOUSE, FUNAFUTI ATOLL, ELLICE ISLANDS.

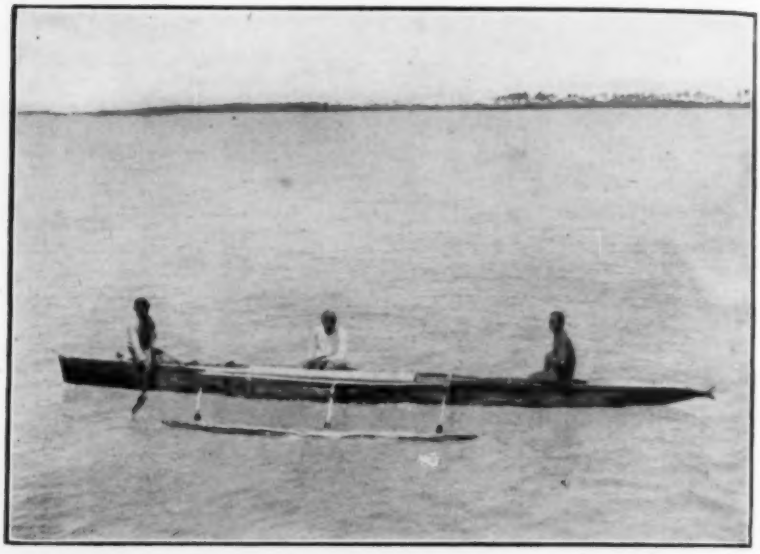
Forests rich with fruit, and many a stream and coral reef afford sustenance in abundance to the natives of these favoured regions of the tropical Pacific.

But there is another, much commoner, and wholly different type of island—the atoll. The popular idea that atolls are circular or regularly elliptical in outline is false, for they commonly consist of a straggling line of long, low islets enclosing with many breaks an irregularly-shaped basin, or lagoon, the bottom of which is quite level and about one hun-

A House of Funafuti, Ellice Islands.

dred feet in depth, although often many miles in width. Another erroneous impression is that the islets are composed mainly of coral. Broken fragments of corals are cast upon their shores, it is true, and may form an irregular wall twelve or more feet in height along the seaward beach, but usually the bulk of the material forming the islets is composed of fragments of shells, calcareous plants, and other organic limestones which after being churned and pounded in the surf are finally tossed up by wave and wind, above the reach of the sea.

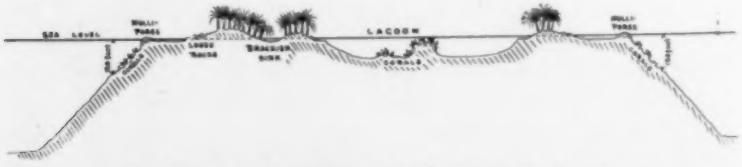
Darwin thought that atolls owed their formation to subsidence. He imagined a coral reef encircling a volcanic cone. Then should the volcano slowly sink beneath the sea, the ring of coral would as constantly grow upward until finally the central mountain would disappear leaving only the ring of the coral reef. Simple as this hypothesis appears upon paper, it does not accord with the observed facts, for it



THE FISH-TAILED CANOE OF FUNAFUTI ATOLL, ELLICE ISLANDS.

fails to explain the remarkable flatness of the bottom of the lagoon with its prevalant uniform depth of 20 fathoms.

The general seaward slope of the atoll is nearly 45°, so that one commonly finds a depth of three quarters of a mile within a mile from shore. Only the upper part of this slope is, however, covered with living reef-corals and these form a mere veneer between depths of 120 feet and the surface. Indeed, the upper rim of the reef is apt to project as a low ridge several inches above high tide. This ridge is dull red in color, and consists in a dense growth of stony sea-weed, *Lithothammion*, and nullipore.



DIAGRAMMATIC SECTION OF A TYPICAL PACIFIC ATOLL.

Between the nullipore ridge and the shore there is a submerged platform over which the breakers drive so fiercely during storms that few corals can cling within its scanty crevices. This platform is usually from one hundred to six hundred feet wide and its floor is commonly not more than three feet in depth at low tide. The seaward beach of the island is a chaotic mass of dead and broken coral-heads which have

been torn from the outer reef and driven inward over the platform to be cast high above the wash of ordinary waves. On the lagoon side, also, we sometimes find the same conditions repeated upon a miniature scale; the slope, the platform, and the wave-raised coral-heads being similar to the corresponding formations of the seaward side of the islet, but the nullipore rim is commonly absent from the lagoon side for these limestone-making plants thrive only in heavy breakers.

In the center between the seaward and lagoon-ward ridges, one finds the lowest part of the islet, this region often being below sea level, and forming a brackish swamp, whose noxious waters constitute the only drinking supply of the atoll.

Brain corals and other huge, massive forms grow close to the seaward edge of the reef, where the surges dash over and among them, but the forests of fragile stag-horns (*Acropora*) thrive best in more protected places. Others called the *Fungiidæ* are attached, only in early life, by a slender stalk which soon breaks, and they then lie loosely upon the reef like petrified mushrooms pushed about at the caprice of the waves. Others (*Siderastrea*), called "rolling stone corals," may break loose and be rolled about, the upper side always regenerating and growing so that the mass becomes egg-shaped or spherical. In general, however, as has been shown by Vaughan and others, the small branching and slender forms must grow either at considerable depths or in protected places to withstand the rough treatment of the sea, thus the deep parts of the seaward precipices of the coral reef are

A Canoe upon the Lagoon Beach of Funafuti Atoll, Ellice Islands.

A BELLE OF FUNAFUTI, ELLICE ISLANDS.

covered with fragile corals, *Oculina,* and *Eusmilia,* and the leaf-like *Turbinaria* and *Agaricea* secure in their quiet depths beneath the agitation of the storm.

Reef corals do not commonly grow, however, at depths greater than 100 feet, and indeed the most flourishing are in water less than six feet deep, and some are even laid bare at the lowest tides. In times of hurricanes vast masses of broken coral are caught in the rush of the waters and tossed far up upon the outer edges of the reef flats, and rocks weighing tons may thus be lifted fully fifteen feet above the level of

the sea. In this manner the originally submerged rim of the reef has in some places gradually been raised, new corals growing upon the shattered fragments of the old, but we must always remember that the slow persistent effects of everyday conditions have far more to do with shaping atolls than have hurricanes.

In coral reef regions, the bottom of the sea is often found to be covered with fine white limestone mud. This becomes converted into rock and may form plateaus thousands of square miles in area and hundreds of feet thick as in the Bahamas and in Florida. This chalky deposit was formerly called "coral mud," but recently, Drew and Kellerman have shown that it has no relation to corals, for according to these authors the warm surface waters of the tropical ocean are infested with bacilli which set up a complicated chemical reaction that enables the calcium to combine with the dissolved carbon dioxide and to form a chalky precipitate, the myriad little granules of which may possibly cause the wonderful blue color of the tropical sea. In any event, in the Atlantic this precipitate sinks to the bottom and there forms into oolite in the manner described by Linck and by Vaughan.

It may be of interest to observe that the relative paucity of nitrogen in the waters of the tropics may account for the few seaweeds found in warm regions, for nowhere in the tropics are there anything like the kelps and fucus that cover the rocks of the north Atlantic shores of Europe and America. Also the scarcity of plant life in the tropical ocean is correlated with the comparative absence of the swarms of floating marine animals such as are so characteristic of Arctic seas, for in cold seas individuals are abundant, but species are few, whereas in the tropics there are many species, but most of them are rare.

In the tropics, where frost is unknown, the moist shell-sand of the beaches is dissolved by rain water and then precipitated, the fragments becoming cemented into a solid rock-mass, this action being especially noticeable between tidal levels, but by no means confined to such places, for in the Bahamas hills several hundred feet high have been formed in this manner out of wind-blown shell-dust and limestone particles. Indeed, rain water charged with carbonic acid derived from the decomposition of vegetation dissolves limestone and thus each little grain of shell-sand is partially dissolved, and then, if the water evaporates or the limestone be precipitated, the grains become cemented one to another by little bridges of calcium carbonate, and thus a *Coquina* is formed, such as one may see at St. Augustine in Florida, and on most of the atoll islands of the world.

Currents, waves, and winds have much to do with the building up of the islets of the atolls. The waves press constantly over the rim, and the basin of the lagoon is filled to overflowing, so that most of the water thus driven into it must escape on the leeward side. Accord-

CANOE DRAWN UP UPON THE BEACH AT RONGELAB ATOLL, MARSHALL ISLANDS. The sail is covered with a thatch of pandanus leaves to protect it from rain. The little deck-house on the outrigger is for storing food when voyaging.

ingly, the deepest openings are always so placed that we must beat up into the wind in attempting to enter the lagoon. Practically every deep entrance into a Pacific lagoon is partially blocked on the inner side by an islet which has formed in the vortex from materials drawn together by the outrushing water.

Even when the tide is high, there is apt to be an outflow of water through all openings on the leeward side of the atoll, but at low tide the whirlpools and breakers in such places are often fearful to behold.

In opposition to Darwin's theory, an hypothesis, prominently presented by Professor Reginald A. Daly, is gaining ground. This states that the great polar ice-caps of the glacial period must have been formed from water taken up from the ocean by evaporation to constitute the snows of the polar regions. Thus the level of the trop-

ical oceans of those days may have become about 120 feet lower than at present. Now, if this were the case, the sea would wash away the shores, forming platforms at sea level for the corals being mainly killed by the low temperature could not protect the Island from the waves. Then, when the ice-caps melted and the ocean rose and again grew warm the corals growing upon the outer edges of these platforms formed the present atolls and barrier reefs. If this be true, all the modern coral reefs are upon platforms which the corals themselves did not build up, but upon which they merely grew after the glacial epoch. In confirmation of this, Andrews has shown that the platform upon the seaward edge of which the barrier reefs of Australia have grown, extends southward beyond the latitude of coral growth. We may observe that it also extends northward to New Guinea, beyond the region where the corals are killed by the silt from the Fly River. Dr. Vaughan has also demonstrated that the platform upon which the Florida reef has grown extends northward from Fowey Rocks into a region too cold for corals, and he shows that this relation appears to be general among coral reefs.

As one approaches the atoll presents a charming picture. At first only a line of cocoanut palms seemingly arising out of the ocean itself. Then the white glint of sandy beach and, finally, we sail through a narrow opening and find ourselves securely anchored in the limpid

Sea-going War-canoe of Uola Island, Truk Group, Caroline Islands. Canoe 25 feet long.

PRIMEVAL FOREST OF QUEENSLAND, NEAR KURANDA.

waters of the calm lagoon surrounded by a narrow broken ring of islets.

Glistening and brilliant it lies with the sunlit sea around it, a shimmer of turquoise and emerald set in the everlasting blue of the Pacific where the flash of flying spray gives action to the scene. With its palm groves bending to the breeze, its alabaster beach, and by contrast the soft co'ors of withered thatch where palm-leaf houses nestle beneath the shade along the lagoon's shore. All splendid and sparkling, none can resist the invitation of its charm.

But once on land, one is doomed to disappointment. The natives

BARRON FALLS, QUEENSLAND, AUSTRALIA, IN THE DRY SEASON. These falls are about 700 feet high.

are starved and sickly in comparison with their more favored cousins of the high islands. The scintillating heat of the blistering sands, the sparse and thorny plants of less than fifty kinds, redeemed only by the cocoanut and the pandanus, without which man must starve or die of thirst—all illusions vanish in the stifle of the barren, glaring, thorny place and we long for the ship's cool deck and the awning's gracious shade. Life is poor and dull upon these atolls, rarely more than an

COCOANUTS AND OLD VOLCANOES OF RARATONGA, COOK ISLANDS.

eighth of a mile wide, with neither hills nor valleys, without streams or springs, and with the heavy murmur of breakers forever in one's ears.

Pure drinking water is the most prized luxury of the atoll. To obtain it, the natives cut furrows extending diagonally down the stems of cocoanut palms and leading into a cavity cut in the trunk of the tree, within which a few ounces may collect. Failing of this meagre supply, they resort in time of drought to the mosquito haunted swamps which occur here and there in the center of the islet.

Thus it is that the natives of the atolls are less cultured, less interesting and poorer both in material and intellectual things than are their relatives upon the high volcanic islands.

An intermediate geological condition is seen in another type of island which the non-geological traveler is apt to confuse with the volcanic, but which is actually only an elevated atoll or coral reef. In vol-

canic regions, considerable local oscillations of level are common and it is known that between the fifth and the twelfth centuries long stretches of the shore of the Bay of Naples sank forty feet beneath the sea and then rose 20 feet above its lowest level. In the Pacific greater oscillations have occurred, for some of the coral reefs of the Fijis are now more than eight hundred feet above the ocean, and other examples of elevated atolls or coral reefs are found in Niue, Eua and Vavau in Tonga, and in Makatea of the Paumotos islands.

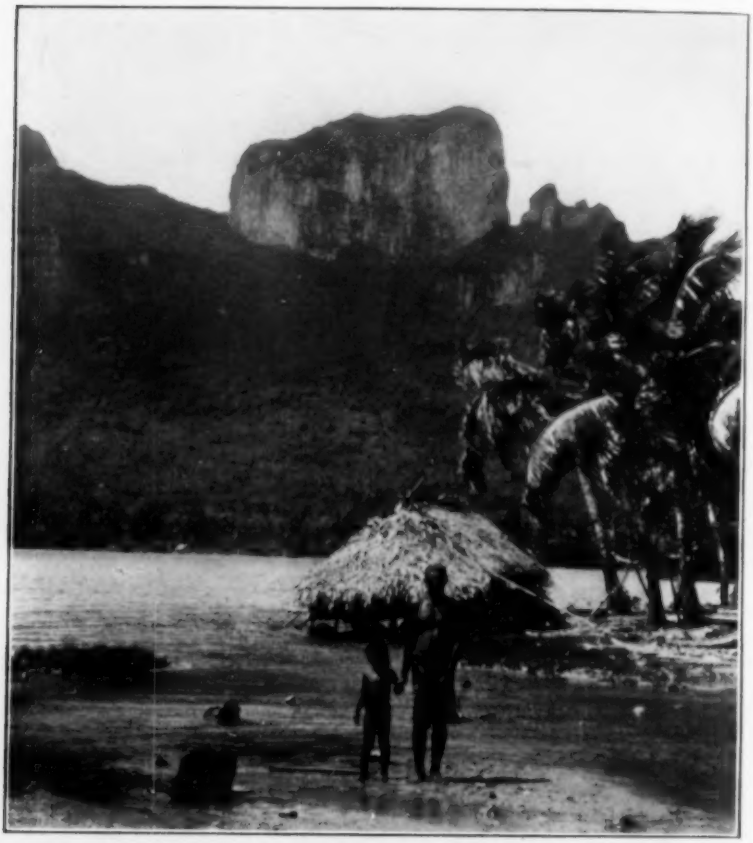
In these elevated coral islands, bold precipices of dull gray limestone frown gloomily upon the sea, their hostile walls stained here and there a rusty red where coral heads have decomposed, leaving the ruddy stain of iron. Caverns with stalactytes drooping like curtains from their roofs are found along the steep face of the cliff, and within them the chiefs of other days lie buried. In places the sea gains access to these caverns, and in the darkened pools live some of the creatures whose true home is upon the dimly-lighted bottom of the sea, 1,000 feet below the surface. Yet here in the everlasting shade flower-like crinoids crawl slowly over the rocks, and long, lythe sea-whips (*Alcyonaria*) coil and uncoil in the dying surge that wanders to their far retreats.

The torrential rains of the tropics have for ages been beating down upon these elevated coral islands so that the whole surface is a riot of jagged projections. If flames were by a magician's wand suddenly turned to rock, they would not be more grotesque or flaring than these knife-edged masses which everywhere project over the surface of an elevated coral island. Here and there and everywhere the mouths of treacherous caverns yawn to entrap the traveler. So clinker-like is this barren rock which rings with a metallic sound when struck, that the non-geologist at once concludes that the island is volcanic, and only the sight of corals heads imbedded here and there in the scoriaceous-looking mass will convince him that he is treading upon an elevated reef. One's boots are torn to shreds, yet the bare-footed natives leap from crag to crag uninjured; a marvellous example of the superiority of natural shoe-leather.

The soil of these islands collects in the numerous crevices, and here the banana grows in the dark-red ferruginous earth that gathers in the bottom of many a pit. Thus the older these islands, the deeper does their soil become, so that at Namuka, Vavau, or Eua in Tonga, or in Niue, we find the surface covered with a rich rusty soil which supports a vegetation almost as varied as that of the volcanic islands.

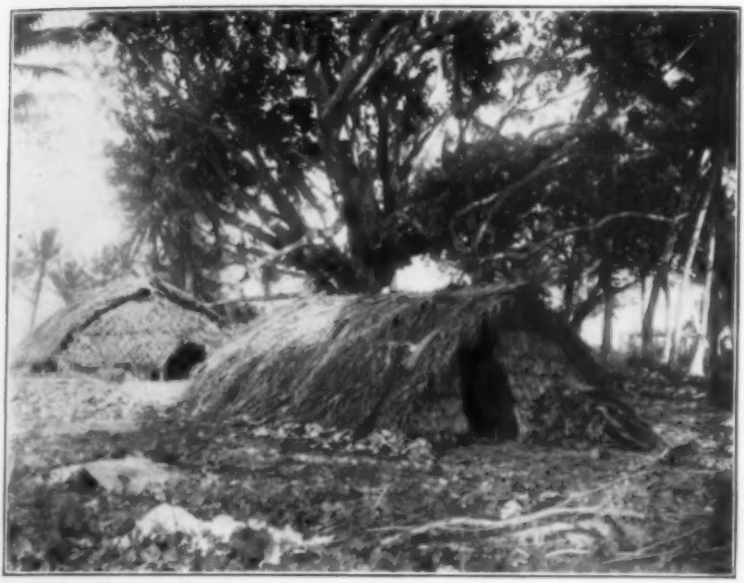
Only half conscious of the present, wantonly forgetful of the past and heedless of the future, life in the south seas passes as a day-dream, a reverie aimless as the airs that trifle among the palm leaves only to lapse into the nothingness of things that were. Yet nature in the

tropics is a trixy jade, and at times drops her seductive, soothing ways and rushes headlong into tragedy. All other memories may lapse into forgetfulness, but the day and year of the hurricane is recalled, and the story of it passes into myth and is handed down from generation to generation.



THE BASALTIC PEAK OF BORA BORA, SOCIETY ISLANDS, showing the trade wind in the palm trees.

Hurricanes come in the autumn; in that season when the long, hot calms of the tropical summer are about to break into the steady trade winds of the winter months. Thus in September and October in the West Indies, and in February and March in the South Pacific, the heated air rising above the sea is believed to set up an inrush from all sides and a great whirlwind gathers, aided probably by the close proximity of the developing trade winds, and by the rotation of the earth, for the swirl is always contra-clockwise in the northern and clockwise in the southern hemisphere, while the storm as a whole



NATIVE HUTS AT JALUIT, MARSHALL ISLANDS.

drifts with the currents of the upper air in a curving course to westward and then away from the equator.

The hurricane of fiction is always preceded by an ominous brooding calm with a sky of sickly green against which palm leaves stand out

CANOE LADEN WITH MATERIALS FOR CONSTRUCTING A HOUSE, FIJI ISLANDS.

SACRED BATS OF HIHIFA VILLAGE, TONGATABU.

like spikes of copper, but in reality the great storm is usually ushered in by gales which increase in violence until they break into a riotous tumult.

COCOANUT PALMS. LAGOON BEACH OF FAKARAVA ATOLL, PAUMOTOS. Robert Louis Stevenson lived within this grove.

The very air becomes an entity, a thing real as the rush of water, overwhelming all in its path. A roar, unearthly in its might, rises at intervals into wild shrieks that overwhelm one's voice. The solid rain drives horizontally and buildings leak more through their sides than through their roofs. The crests of waves are blown far and away, and the sea flattens under the crushing pressure of the storm, the dark waters hidden beneath a white sheet, gray swirls scudding ghost-like over all. The wind comes, not straight, but in fearful twisting swirls and bits of seaweed strike against lighthouse windows one hundred and sixty feet above the sea. One stifles. The air, no longer a pellucid nothingness, has become an enemy against which one can

HOUSE AT PAPARA, TAHITI.

not stand; above which one can not shout, and, in the mighty presence of which, man is an ant-like thing, his smug assumption of mastery over nature a ridiculous pretence. There is no protection anywhere, even the strongest, highest wall serves but to create a maelstrom behind it.

The trunks of stately palms bend humbly to the onrush until they thrash upon the ground, or tearing loose fly upward into the vapor of the storm. Great trees fall, but one hears no crash; houses change in shape and crumble and there is no noise from them, for all sounds of earth are as silence in the presence of the vast voice of the air.

Then, after hours that seem as years, as if all nature had fallen

into war and peace could never come again, the wind unexpectedly ceases and the demon of the storm smiles down upon a blighted world. A candle flame may live in the sullen air, yet all around the horizon lies the black wall of the hurricane glistening in silver where it presses on the sea, and a confusion of huge waves come toppling in from all directions, crashing one against the other, and the barometer sinks to its lowest level. Afar off, one hears again the dull roar, then onward it comes with sudden fury, but reversed in direction, to finish the work of destruction it had but half accomplished.

After all is over the sun—the long-forgotten sun—shines out upon a land, hideous in its ruin. The forest lies in shattered skeletons and dangling here and there are blackened rag-like things that once were leaves. The houses of the village lie shapeless, strewn among the common wreckage of the palms where the great waves let them lie, and strange rocks weighing tons have risen from the sea as monuments to the reality of nature's awakening in a region where once she seemed but to dream and soothe with gentle airs and flirt with all things real.[1]

Yet tropical nature knows no mourning and laughs at death and ruin. New life seizes covetously the lost places of the old and in a few years only the trained eye of the native can detect traces of the work of the great hurricane.

Once or twice in every generation each island is devastated by such a storm. Yet so wanton is tropic life, so heedless, listless and resigned to things that are, that nowhere in the South Seas have the natives taken the trouble to construct hurricane-proof refuge houses into which the village might retreat in time of need.

[1] Such a rock is to be seen upon the reef-flat of Lottin Harbor, Kusaie Island in the Carolines. It is 15 feet long, 8 feet wide and 8 feet high.

THE RACES OF BRITAIN

By WM. H. BABCOCK
WASHINGTON, D. C.

NOW that several great world powers are engaged—among other things—in violently rearranging the map of Europe, perhaps more nearly on ethnological lines, we may profitably consider the racial composition of those powers themselves. Not the least of them is the wide-flung British Empire, having its center of life in the ancient island of Great Britain. We must also touch upon her companion Ireland, for they have acted and reacted on each other by partial conquest and peaceful immigration since before the dawn of history.

British ethnology has an especial appeal to Americans, since what was true of the one country in such matters was very nearly true of the other at the time of the revolution and separation. Of course, all the elements of the British islands were more perfectly fused here than there, since, even in rural England, Dr. Beddoe points out many streaks and patches of population of different and even contrasted appearance; also the Indians had added something; and we all know that there were many Dutch in New York, many French creoles in the southwest and divers other accessions of less bulk from various quarters; but even long afterward De Tocqueville—a keen and philosophical observer—could still define Americans as that branch of the English people to whom a special work had been assigned, evidently with no thought of any essential divergency. Since then we have had a great flood of unequally distributed immigration, which has repeatedly changed its source and quality; but it has left extensive areas comparatively unaffected, and, in part, it has been assimilated in other areas, often with little obvious change in the assimilating body. Of that great assimilating and determining body of American people we may still say that in language, blood, customs, laws and aspirations it is more akin to Great Britain than often happens in the case of two great independent nations. Indeed, I do not recall any instance of equal similarity on a large scale.

Language is of course an uncertain guide as to race, but it is often a clue and always significant, always a surviving record of history, lost or remembered. Now, Great Britain is conspicuously an island of three languages, not mere dialects, but completely organized, historic, distinct developments of human speech. All are of the Aryan family of languages, two belonging to the Celtic group of that family, the third to the Teutonic group and its Low-German subdivision, which includes also Dutch and Flemish. These three languages of Great

Britain are English, occupying exclusively by far the greater part of the island; Welsh, a modern remnant of old British, spoken still in the western mountains; and Gaelic, spoken in the northern mountains of Scotland, also, far west of the Welsh, in parts of Ireland and in some intervening islands. As might be guessed, these three languages are relics and records of three great waves of invasion and conquest, with intervals of several centuries between them.

Another interesting fact is the permanency of the situation above outlined, which is not substantially different to-day from what it was in the sixth century when Gildas wrote. The Saxons were then in possession of all the eastern part of England, excepting some isolated fastnesses; the Britons were west of them in the mountain country and the tracts just above and below it; the Gael were beyond in Ireland, probably also on the seaward side of the British territory; also far north in the Highlands. It will be seen that the greatest difference is in the spread of the intrusive Anglo Saxon (now English) speech, accompanied by a like displacement of race, on a great scale, though much less in degree: but these do not affect radically the general map arrangement of tongues and peoples—then newly, but perhaps finally, accomplished. There have been other great invasions and long-continued occupations of Great Britain since then—the Danish, the Norman—as there had been one before in historic times, the Roman; but none of these changed the speech of any part of Britain, except by supplying a few words for our present English vocabulary. Their changes of population, though real, are either matters of debate and uncertainty, or have dwindled, as in the case of the Danes, with the lapse of time, and in no instance present a solid mass of men so sharply marked off from their neighbors as the Welsh or the northern Gael. It is well, therefore, to bear in mind this division into three parts, English, Welsh and Gaelic, as the most conspicuous fact of Great Britain's racial and linguistic history for the last 1,400 years.

The Angles, the Saxons and cooperating tribes came chiefly, as we know, in the fifth and sixth centuries of the Christian era; the Britons and the Gael much earlier, though the exact periods are sufficiently uncertain. Whatever the dates, these were three successive waves of blond people, no doubt including some darker elements and differing from each other more or less in kind and degree of blondness, but such as we might expect to leave a predominantly light-tinted and light-haired population in Great Britain as the total result of their successive blond overflowings—if there were no counterbalancing influence that was even more important.

There certainly seems to be such an influence; for there are more dark or medium-tinted people in Britain than the positive blonds of all kinds taken together; and almost everywhere, perhaps everywhere,

the darker people are gaining in numbers on their lighter kinfolk. These facts can not be adequately accounted for by later dark immigration. Such undoubtedly occurred and indeed has not ceased even yet, but would be offset in great measure by blond immigrants other than those above mentioned. The most natural and now generally accepted explanation is that the Gael (or the first Celtic-speaking invaders) found before them a darker population, which was more numerous and also better fitted to survive and perpetuate its characteristics by reason of long occupancy and acclimatization. There can be little doubt as to the first item and surely none at all as to the second, at least so far as concerns some of the elements of those pre-Celtic people; for it is quite obvious that they would comprise the residua of all previous conquests and immigrations, except of course such temporary visitors as may have gone away again, leaving none behind, and such feeble folk as may have been utterly exterminated. Only the latter process could remove those who had penetrated far beyond the shore, and it is hardly credible in any instance in so extensive a region abundantly provided with places of refuge. In truth, the complete extirpation or removal of a race is an unknown, or excessively rare, thing in human history.

It would be important and interesting to consider the composition of this pre-Celtic population, if we had sufficient reliable materials to go upon, but, as matters stand, it will be better to content ourselves with a very brief superficial glance at the successive human waves which had reached Britain. Perhaps the earliest comers walked there, while as yet the waters had not come through the English channel nor spread out to form the North Sea. It is said that some of the earliest relics of quite certainly human anatomy and human handiwork in all the world have been found in very recent years in the low southeastern counties of Britain, which were the regions naturally first entered, and most abundantly peopled, by nearly all later comers so far as we know. To reach the period, we must count our years back by many scores of thousands, some have guessed a quarter of a million more or less. Naturally, these people were rudimentary in every way and we are always at some risk of mistaking the random stone-splinter work of nature for such poor beginnings of human tools as they have left. They must have existed among dangerous creatures and alarming natural forces by a combination of good luck and negligent sufferance, helped out by a barely human craft and embryonic industry. From that time on, through the enormous stretch of the paleolithic horizons, we may picture mankind in Britain as a grotesque procession, trampling up out of its grotesquerie, improving in bodies and in tools from age to age, though disturbed by sudden irruptions from distant regions. Some have thought that certain types of man, long conspicuous in early Britain, came from the far east, others from the hot south now known

as Africa. It can not be said that there is a regular succession of improvement in race in Europe anywhere; for some of the early types were quite respectable in their development of brain and body, while others have an abnormal and portentous look. In some instances divers anthropologists have ranked them as of different species from our own, though still quite human. What is true of Europe generally must in the main be true of Britain, although the evidence from its less ample and more remote area is naturally less abundant and complete. It seems more than likely that two or more of these very different kinds of men, of quite diverse attainments, though in no case of a very high order, would often be found in Great Britain at the same time. Perhaps few of them would correspond at all closely to any variety of man that we know until the latter part of the paleolithic age, an enormous reach of time having many stages.

There is a little evidence, perhaps not quite convincing, of strange survivals even until now. Thus Dr. Beddoe writes in his Races of Britain:

> I think some reason can be shown for suspecting the existence of traces of some Mongoloid race in the modern population of Wales and the west of England. I have notes of 34 persons with oblique eyes, the iris is usually hazel or brown and their hair straight, dark brown, black or reddish. This type seems to be common in Wales in West Somerset and especially in Cornwall.

He has found no such instance from the east of England and "very few from Ireland," but adds:

> I believe that specimens of it might easily be found in the mountainous parts of Connaught, especially on the borders of Sligo and Roscommon.

Again he says:

> There is an Irish type which I am disposed to derive from the race of Cro Magnon. In the west of Ireland I have frequently seen it. It is said to be common in the Hebrides.

He cites an article of Hector McLean on this and adds:

> Though the head is large the intelligence is low and there is a great deal of cunning and suspicion.

He refers also to prognathous specimens, a type often overlapping with the Mongoloid, but different, as being common in Dorset and Devon, especially toward Exmoor. He says its characteristics can not have been caused by oppression and misery, the conditions being otherwise and the average height of thirty-four of these people being five feet seven inches. He mentions also finding this type in the rougher parts of Ireland and says:

> While Ireland is apparently its present center, most of its lineaments are such as lead us to think of Africa as its birth place. I believe this Africanoid type to be of high antiquity.

The paleolithic people, like nearly all later occupants, seem to have left their underground relics most plentifully in the extreme south and southeast of Great Britain. Like most others too, all varieties of them would be successively driven to the forests and mountains or even across the water to Ireland (if they could get there), and in the last resort to the wildest nooks of that island also. It will be noted that those are the very parts of both islands where Dr. Beddoe thinks he still discovers some traces of them in living men and women. But the paleolithic population at all periods and of every kind must have been scanty, for hunting and fishing will not support many people and there is no reason to suppose that they had other resources. In the rugged regions where they found refuge they would never greatly increase. Consequently their practical influence on the inhabitants of the richer parts of both islands must have been very near zero for thousands of years. So there need be no particular concern as to the finding of some supposed Negroid, Mongolian or other characteristics, alien to the white race, in individuals of sequestered mountain and moorland communities.

There is another sort of evidence, which Dr. Mac Ritchie has collected rather abundantly from tradition in a very interesting work on Ancient Britain, going to show that there were quite wild and dangerous savages, apparently remnants of some early race, running at large in the highlands of Scotland in periods very much later than that with which we deal. It will be remembered that there were similar legends, in even more exaggerated form, of prodigious folk, in the southwestern British moors and along the rougher part of the sea border. These giant-tales may preserve nothing real, but again they may record a racial memory on the part of later and more civilized occupants of those who never become inured to quiet ways, but long continued to exist in forest and mountain recesses. They seem to have nothing in common with the next occupants of the land.

So far as we can judge, the paleolithic people of whatever kind were overwhelmed by a relatively great influx of neolithic people, who were pastoral, agricultural, better organized and more advanced in every way —possibly ten, fifteen or twenty thousand years ago: it is not a matter as to which we can set dates. Sometimes they are called Picts, a name which lives both in legend and history and no doubt has sometimes been applied rather loosely to their various allies also, or to people confused with them. In Ireland the name fir-bollig was also applied to a great body of people who long continued to resist the conquering Milesian Gael. Doubtless they too included heterogeneous elements; but the dominant pre-Gaelic and pre-British type seems to have been on the whole the same; and to be abundantly commemorated by the long heads and dark hair of the majority of the people in both islands, characteris-

tics which belong also to what is sometimes known as the Mediterranean or Iberian race of southern Europe.

Compared with some earlier and later occupants of England, they present a gracious and winning, if not powerful, aspect. As shown by their long barrows or grave mounds, which were often provided with a stone chamber, accessible by a stone-walled passage, they were fairly tall (about five feet five or five feet six), rather slender, though not always, mild of feature, having fine small jaws, long-headed with good brain capacity and undoubtedly dark, resembling the long-headed inhabitants of Gaul. They knew nothing of any metal except gold, unless in their later stages. Yet they were able to produce so impressive a monument of industry as Stonehenge, with its great monoliths brought from a distance and neatly worked in the below-ground parts as well as those that are above ground—a feat quite impossible to any but a large settled and organized population, feeling the need of religious and political centers. Notable defensive works have also been ascribed to them; and some have supposed that the druidic system originated with them and passed on later to their successors, the Gael and Brython.

There seems no conclusive evidence of intermarriage with their predecessors; perhaps the difference in methods of living would prevent this, except in rare instances, also the sparseness of the earlier hunting population, already alluded to. There is some slight evidence of heterogeneity in their anatomy, and the burial customs differed in various regions; thus the long barrows of southwestern England contain cremated bodies; those of Yorkshire, bodies buried intact after our fashion; whereas in northwestern Scotland they are about equally divided between the two methods. But, with slight qualifications, the evidence throughout Britain seems to indicate one fairly homogeneous race, at least in the more open parts, where the barrows are generally found; and there is no great reason to doubt its general prevalency.

Much discussion has always occurred, since men interested themselves in such matters, over the Pictish language as spoken in Scotland, some fragments of which have come down to us, mainly in lists of names and inscriptions, sometimes variously interpreted or beyond interpretation. Dr. Skene and others have considered it an archaic form of Celtic; but Sir John Rhys believes it to have been originally non-Celtic and even non-Aryan, though so deeply overlaid with Celtic accretions that it has often been mistaken for a variety of Gaelic or a variety of British—as he would say of Gaulish, meaning the same thing. Elsewhere he has pointed to other slight survivals of pre-Celtic speech, notably in the first syllable of Islay, often recurring in other combinations, and divers place names all over the island which are not to be explained by any known Celtic or post-Celtic language.

After the Picts or Fir-bollig or whatever we should call them, came

at a long interval a tall race of people provided with bronze swords and spears and no doubt instructed in arts of war, perhaps also of peace, beyond their predecessors and victims. Evidently the slighter forms and especially the primitive stone weapons opposed to them, were doomed to the complete subjugation that certainly followed; although there are indications that in some regions this was delayed—remote natural fastnesses where the beaten race was packed in great numbers and held together after sufficient time had elapsed for it to acquire and become familiar with the appliances of the aggressors. But the almost complete vanishing of every intelligible remnant of the speech of the conquered people is sufficient proof that this conquest was exceptionally sweeping, thorough and unyielding.

Probably the Gael were the chief builders of the round barrows which succeeded the long barrows, as the Celtic tongue succeeded whatever was spoken before; but now we find, as we did not find in the former instance, two types of skull, the long and broad, sometimes intermixed, which is taken to show a very early partial blending; this being more likely to occur where a numerous and sedentary population was overcome and partially enslaved. Those round barrow interments were usually, it seems, of the ashes and larger bones only, cremation having taken place at some other point: but the skulls have generally remained intact, and Dr. Rolleston, who examined many of them, collected by Mr. Greenwell, declares that these bronze-age mounds have the two types of skull in about equal proportion, whereas the skulls of the pre-bronze age mounds are all long. So it seems that in the bronze period the skulls of Britain, after a great intrusion of broad headedness, were already conspicuously on the way to become, as now, chiefly long headed again. This was in spite of an additional, but relatively small, independent intrusion of dark broad heads, perhaps from across the North Sea, a type which Dr. Beddoe finds here and there in Scotland, for example, in Fife and East Lothian. But there seems no reason to doubt that the round barrows of Britain were principally the work of bronze-using Celts, and especially of the Gael; and that these were blond, large-limbed people of strong, formidable, aggressive features and some proficiency in decorative arts, metal-working and whatever pertains to success in war. It may be that their really best work was done after they had settled down in the British islands. In their later period at least, their women could spin and weave well and their soldiers went armed with steel.

Apparently they had been great wanderers, like many early people. It has been thought that their original seat was in the general neighborhood of the foothills of the Alps on both sides of that mountain barrier, notably in the upper valley of the Danube and in northern Italy. Their route may have been partly through southern France to

Galicia in northwestern Spain, thence by sea to Ireland, then to Wales, Devon and England generally; also partly across northern France to the English Channel, then across into Britain. Curiously there are less positive indications of the latter journey: but, on the other hand, the plainest relics of eastward Gaelic movement in Britain may well belong to a much later time. These are among other things, inscriptions in the Ogam alphabet, peculiar to the Gael, which are fairly plentiful in South Wales, Cornwall and Devonshire, but decrease in number to the eastward, until but one is reported from Hampshire, among the ruins of Calleva. We know of Gaelic inroads and settlements well on in historic times which took this general direction, starting from Ireland.

However they came and wherever they landed, it seems very probable that the Gael gradually won possession of nearly all Britain and Ireland, though Fir-bollig Galway at least long maintained a precarious local independence. Probably the metal weapons had even more to do with this success than their great physique and aggressive temperament. Of course the result does not imply that the earlier people all became Gaelic. It means that they had Gaelic speech and some Gaelic institutions forced upon them, or found an advantage in substituting those for their own. This Gaelic conquest occurred somewhere in the latter part of the bronze age.

The British or Brythonic invasion belonged to the age of steel weapons and may have been facilitated by a better supply of these, as the Gael in their time had defeated their darker predecessors by the superiority of bronze weapons over stone. Rhys thinks that the British Celts probably came at some time between the visit of Pytheas, who seems to have circumnavigated the island about 330 B.C. and landed on it at many points, and the incursion of Julius Cæsar about 55 B.C. Cæsar certainly found them there, but no one is quite sure whom Pytheas found. On the whole it seems most likely that the transfer of population began considerably before his time, but continued later. The last was no doubt true of the final British northward wave, the Belgæ, who were perhaps more or less modified by earlier contact with the Teutons and may have had some Teutonic strain in their blood.

It is likely that the original seat of these Belgæ and perhaps of all the British Celts was in or near Belgium; but they undoubtedly came to Britain for the most part across the Channel from the region where the great armies are now battling. Cæsar found the loosely affiliated tribes of the Belgæ in all northern Gaul or France, but no less in southern Britain from Kent to Hampshire inclusive, and observes that there was little difference between the speech of Britain and that of Gaul. Arras was the Gaulic capital of the tribe of the Atrebates, the elder name having been gradually worn down into the modern one; but they had also a British capital in Hampshire, which later became

the distinguished Roman-British city of Calleva Atrebatum: its ruins have been exhumed on the site of the modern English village of Silchester. Cæsar found the king of the Suessiones ruling over territory in Britain as well as territory in Gaul, and his seat of government bears still the name Soissons, hardly changed at all in spite of many vicissitudes and storms and bombardments. The name Britain itself has sometimes been derived from the Brittanni, who dwelt in the valley of the Somme but removed in numbers to Kent, where they would be more often visited by traders than the inhabitants of distant regions, and their tribal name might possibly come to be used for the island as a whole. Indeed at every turn familiar names crop up from this old time, though most often on the southern side of the channel, where the later hostile inroads were less sweeping and ruthless.

There were however some differences between the populations on opposite sides of the Channel, if we may believe the Latin writers of that period; as indeed there will often be in different parts of the same nation. Thus we are told that the Britons were larger than the people of Gaul, some of them being half a foot taller than most other men; that their hair was less yellow than that of the Gauls and their bodies were not so well set or handsome; that they displayed more vehemence and fierceness in combat; that they were notable for their loud clamor and for going into battle nearly unclad with swords hanging beside their naked bodies; that their wealth was in their cattle; their method of living notably simple and frugal and that they harvested their grain without threshing by cutting off the heads bodily, presumably by the use of a sickle. This method has been revived recently in the case of freshet-flooded grain.

Sometimes these writers may have chiefly had in mind the remoter non-British, or but slightly British, aborigines, as the Britons called them. Other distinctions may be local for single provinces or districts. Of course there would be much confusion between these, but, allowing for a real residuum of average British difference in physique and ways, we may still say that the Britons were transplanted Gauls—in southern Britain Gauls of the Belgic subdivision—and Cæsar says that their speech differed little from that of the neighboring mainland. Rhys has preferred to call them Gauls; but the name is geographically misleading and besides liable to confusion with Gael, which probably had the same root. More frequently the name Brython has been applied to them, but it is unfamiliar to most ears and may seem to savor of affectation. I have preferred the well-known term Briton in this paper, especially as both Romans and Saxons best knew them thereby; although in modern use it often includes all people now dwelling on the island. Perhaps we stand in need of a perfectly satisfactory distinctive term for the

British people who were not yet Romanized nor Saxonized nor Danicized nor Normanized; but we must do as we can.

Neither the Gaelic nor the British language was homogeneous, nor is so now. Each consists of at least three sub-languages, those of the Gaelic being the Erse or Irish, the Scotch Highland Gaelic and the nearly extinct Manx, spoken on the little Isle of Man; the British or Brythonic comprises the Welsh, the Breton and the hardly extinct Cornish, which has left some literature and many habitual words. The latter three differ more from each other than do the former three. Erse, Highland Gaelic, Welsh and Breton, are spoken over considerable regions and each of them breaks up into distinct local dialects. There is no reason to doubt that dissimilarity in details of population and language was the rule both in Gaul and Britain, as we know it to be still in Brittany, though there would be a fair degree of uniformity in the more advanced agricultural and trading regions. Ireland remained Gaelic in culture; so did the upper part of Scotland and some parts of the sea-coast of Wales, where the original or recently invading Gael had established a great reputation for supernatural power, perhaps implying a certain superiority in some quite human arts over the neighboring mountain Britons or Welsh. This would not, however, imply superiority over the more cultured parts of the British people in the same period.

It is difficult to make a comparison between the Gael and the Britons collectively. The former must have been more influenced and modified by the preceding neolithic people of the island; the latter by the Germanic tribes then crowding westward over the continent and mingling with all races before them. As later comers it is fair to suppose that the Britons would be the better supplied with steel weapons and other appliances: and their successful occupancy of the best parts of Britain is a corroboration. But perhaps the Gael had once been directly in contact with Mediterranean civilization and brought thence a greater aptitude and proficiency in matters of art. Of course, in both cases, it is easy to underrate or overrate the old conditions, especially as the relics in the soil of Great Britain may belong to very different periods of the developing British people.

But we have reason to believe that in the more prosperous regions there had been a considerable amount of human attainment. Cæsar refers to the number of houses and density of the population, though he also describes their towns as mere collections of wattled huts defensively walled round in the forest and mainly intended as places of refuge. However, we hear also of wooden houses; and better habitations were coming into vogue. Perhaps in the main they preferred a more isolated farming life. They built strong hill forts. They had many chariots, some of which gave Cæsar his first hostile greeting in the shallow water of the sea-coast; also he presents a vivid account of the dashing and

skilful tactics of the Britons in managing these engines of war so as to throw the Roman ranks into confusion, while the fighting men would spring off and on at will, sometimes running out along the pole of the neck-yoke and back again—the chariot being in motion. They fought, he says, in detachments, with reserves, and obtained by these vehicles in one kind of force most of the advantages of cavalry and infantry; though we know that they had both of these arms as well. In all the southern regions market centers had grown up, using copper and iron coinage, as well as gold coins in their later period, which were perhaps at their best in Essex. The Druidic system, common to them and to Gaul, was understood to have its origin and chief holy places in Britain and constituted a complex religious organization with elaborate training.

During the long period of Celtic ascendancy in Britain foreign influences were brought to bear upon the coastal country at least. Traders from Phœnicia and the Phœnician colonies of the Mediterranean and Atlantic are believed to have crept up to the ocean side; Greek civilization from Massilia and neighboring towns traveled overland across western Gaul and thence to Britain on similar errands. But perhaps neither of these nor any others stirred the islands greatly or penetrated far inland, unless in the faintest way.

The adventurous incursion of Julius Cæsar pierced more deeply. Though it did not maintain its foothold, it opened the gates, introducing Rome to the islanders and the islanders to Rome. Presently the imperial culture prompted imitation, as will happen everywhere in the human shallows a little beyond the flood of advancing civilized life, so that Cunebelline (Shakespeare's Cymbeline), a potentate of Essex, took heart to set up as the friend of Augustus and to prove his sincerity by aping imperial Rome as best he might. Probably some adherents came to him from regions under the Roman sway.

But before such infiltration had reached the inner parts of the island, the new domination which it foreshadowed came with a rush of arms and men, and all resistance was beaten back to the mountain lands. This Roman conquest threatened Ireland from the western shore, but the storming of Anglesea or Mona was its farthest achievement in that direction. It kept on northward to the Highlands and later pushed nearly or quite through them very briefly; but in the end it was content to stand mainly on the defensive behind a strongly occupied line of fortification still known as the Roman Wall; and to bridle western turbulence by great fortresses or legion cities distributed at points of vantage along the line of probable disturbance—Carlisle and Chester to the northward, Exeter in the southwest among the men of Devon, Caerleon near the estuary of the Severn in what we now call South Wales, and other garrisoned towns of note in the intervening spaces. The southern and southeastern seaboards had their strong

fortresses too; and later, if not at first, the exposed eastern front was systematically guarded by the forces of a count of the Saxon shore.

The Roman occupancy of Britain falls naturally into three periods: the first brutality of conquest; the long peaceful domination when there was neither war nor rumor of war except in a small way with mountain tribes on the remote border; and the era of decay when incursions became frequent and disastrous, usurpers abounded, wrangling, and year by year there grew a dread upon all of being cut off alive from the living mass of men. We remember the first period by the extravagance of cruelty which it employed and provoked—the wrongs of Boadicea and her kindred, the massacre of London; but in the fact that there were already seventy thousand immigrants from the Roman empire to be overwhelmed in that blind retribution, we may more profitably study the great change of population that was already working on British soil.

But this was no adequate measure of the incoming flood. Beside the garrisons of the wall and the legionary cities and fortresses, great colonies of veterans were planted in the open country; merchants and mariners gathered at the landing places and in the narrow streets of the growing river towns, and moneyed men from the Mediterranean, the Rhone or the Garonne took up their abode on lands newly bought or granted, building low colonnaded dwellings of open interior and mighty expansion, of elaborate baths and hot-water-heating systems, of tessalate mosaic pavements and profuse frescoing, such as have never been exactly repeated in England since their day. Of course the wealthier colonists would bring or draw dependents from the continent, with cumulative effect on the population.

Moreover, there was a steady double transforming action by the depletion of native young men, persistently shipped away elsewhere to fight Rome's battles, and the continued importation of foreign blood to fight or curb the more intractable people of Britain. There can seldom have been less than twenty thousand legionaries and auxiliaries on the island between the year 50 and the year 400, men drawn from every corner of the empire—Spaniards, Dalmatians, Burgundians, East Indians, Scythians, Syrians, Gauls and Moors. Most of them brought their families or married there; and hardly any people of the world, however unrelated or uncouth, but was summoned to aid in defending or holding Britain—and incidentally to aid in providing her future sons and daughters. At times, of course, the inflow of soldiery exceeded very greatly the figures above given; as when Agricola overcame for a time the independence of North Britain; or when Severus trampled it down again with armies out of which he lost fifty thousand men.

Of course, the effect was not equal nor nearly equal everywhere. In the towns known significantly as "of the legions"; in London which took the legionary name Augusta; in York, long the military and civil

headquarters of the island, it was necessarily great; also greater than elsewhere along the line of the Great Wall, where a continuous more than half-foreign belt of village population may well have grown up. But there were many fertile valleys and uplands which Roman troops rarely visited; many British towns which rarely saw them except as a mere incident of transit; and in all the numerous forests and marshy regions and the rougher country generally the British blood, British ways and British language most likely continued to prevail; although the people outside of the mountain land had very well learned the futility of rebellion.

The Roman rule in Britain lasted for about four hundred years. During the greater part of that time Rome kept order and maintained a fairly homogeneous civilization in all parts of the island best adapted to civilization and commerce. From end to end of the lower country and from side to side it pushed excellent roads, making transit easy; it built great sea-side and river-side embankments; it very greatly multiplied the population; it fostered a relatively great commerce; it developed cities which would be pygmies certainly to those of our century, but were well built and thriving and beautiful; it distributed widely those kinds of advancement which belong more naturally to the shores of the warm southern sea. It must have taught the native people many things—beside a more or less enervating sense of security under protection; but it has been generally credited with undermining their self-reliance, enterprise and efficiency. Perhaps the distinction between the dominant man-at-arms and the docile native citizen was insisted on too overwhelmingly and persistently. Originality in art did not thrive and the country had no literature with vigor enough to leave any trace. Moreover when the Roman legions withdrew there was difficulty in adequately filling their places, and the makeshifts were battered down at last. It is also a significant and rather wonderful fact that the long and elaborate establishment of the Roman system took so little hold upon the hearts of the subject people that a bare handful of Latin words remain from that period in the popular speech, "way," "villa," "camp" and "castrum"—turning at last to Chester and castle—being the instances that come most readily to mind. Perhaps the enfeebled and transformed Britons who had learned to speak a corrupted Latin either followed their masters away from the island or were killed or de-Latinized by later invaders, or took refuge in wild regions, where their language died away in the speech of those about them. Evidently the great previous development of population came to an end long before the final catastrophe and had taken to dwindling again. Possibly if the Roman soldiery had been heavily reinforced and kept at the Great Wall there might have been a northern Roumania, speaking some sort of langauge derived from the Latin and, like the Roumania of the south-

east, claiming descent from Roman soldiers' families. But nothing remotely resembling this came to pass.

The storming of the northern wall must have made a great stir in its time. Gildas, who is said to have been born near one end of it, and who probably wrote about 560, makes it a notable feature of his altogether too brief combination of diatribe and historic treatise. But, in point of fact, it seems to have happened repeatedly, with intervening repairs and remanning, total or partial. The same is true of fortified places behind it. Recent investigation has shown at least three demolitions and restorations of one of these, and we can fix approximately their dates by the coins lost, left and built over, but now again exhumed. The first destruction was not far from 368 A.D., the last later than the year 400. One such little hoard, dating perhaps from about 385, was found where it had been wrapped up in lead with a gold ring and hurriedly stowed away so long ago, evidently before a sudden onslaught. A coin of Honorius on the line of the wall itself indicates that this part of the work at least, was yet in Roman hands about the end of the fourth century. Perhaps the wall ceased before 407 to be an effective barrier as a whole; though its strong terminal fortresses and possibly some intervening fragments may have held out much longer. The Picts and Scots —that is, North British Highland people and the Irish—are reputed the destroyers—the latter perhaps flanking the wall with their ships at its western end, while their allies made the frontal attack which Gildas describes; but the later successful assaults at the eastern end may have come from the Teutonic assailants who soon grew more formidable. Aneurin's very old Welsh poem "The Gododin," attributed uncertainly in part to the sixth century, is interpreted by Dr. Skene to relate in its earliest section the downfall of one of the eastern fortresses of the more northern Roman wall from the Forth to the Clyde.

There is no detailed and nearly contemporary account of the Anglo-Saxon conquest. Several centuries later the West Saxons put together from their traditions a terse chronicle of the events as they understood them. Fragmentary British legends were embodied about the same time or a little later in the brief history which bears the name of Nennius. Later writers gathered other items and romanced about them. We have little else beside the indications of place names; the physical characteristics of living people in different neighborhoods; and the evidence yielded to archeology by the British soil. Of course the picture of events thus gathered is very incomplete and uncertain.

We can clearly see that both Roman departure and Teutonic inflow were very gradual. Maximus in 383 had carried a great part of the British strength southward, to compete successfully in his behalf for the imperial purple. Apparently it never returned. From that time, with

increasing menace, there must have been a gradual depletion of those who could leave.

In 402 Stilicho withdrew altogether from Britain the sixth legion, which had long been stationed at York; also the second legion, to the forts of the eastern coast near London, from Caerleon upon Usk in South Wales, which had been its settled abiding place for two or three centuries. The latter movement marks the increasing Saxon danger, since the Saxon shore became the only region guarded by regular troops in all the island. This is corroborated and emphasized by certain repairs in the fortifications then made at points along that front.

Necessarily all the north and west of England were left unguarded, or to be guarded by native volunteers and levies. No doubt the latter alternative was taken, for there is evidence that irregulars or native troops had been used for some years before to defend the wall, and the native legends and incidental references in old Welsh poetry make it nearly certain that the provincials adopted the Roman methods and organization in necessarily taking the places of the withdrawn Roman troops. The Roman generals would doubtless help them to make some provision before withdrawing. Probably as long as possible the British commanders would maintain the same headquarters. Thus more than a century later we find Arthur still making Caerleon his stronghold and capital according to Welsh tradition. It may well have come to him through a succession of commanders. Also, considerably before Arthur's time, but no doubt after the downfall of York or Eboracum, we seem to recognize Cunedda as the Duke of Britain holding command at the north.

The defense of southeastern England was soon committed altogether to the British, too. After various disorders and revolutions the sole remaining legion elected an "emperor" Constantine 3d, who, following precedent for the last time, carried it to the Continent about 407 in pursuit of his dream of empire. There must have been some provision hastily made to provide a substitute garrison. Naturally the municipal authorities of the various cities would be called upon for that duty in the first instance and their Romanized town levies would be supported by the still imperfectly Romanized or merely Celtic country people and the tribesmen of the wilder regions, these latter, however, being naturally often out of harmony with their urban comrades.

It is generally recognized that there was such a division, with resulting weakness to the defense. The wilder country people held out longest, but only in a kind of qualified barbarism. Civilization is largely an affair of cities and Roman-British civilization was trampled under the Anglo-Saxon heel.

The British cities were unequally equipped to withstand an assault or seige. London had grown up around a fortress, had been walled very

early and was walled again more amply and efficiently when danger threatened. Calleva probably was not walled at all until after the Romans departed. The circumvallation of Deva (Chester), Anderida (Pevensey) and Camulodunum (Colchester) was complete and strong from first to last. Verulam (St. Alban's), with her admirable amphitheater and many temptations to pillage, remained always open.

Their fate was equally diverse. After long beleaguerment, Anderida was so utterly devastated that we are assured by the victors "there was not one Brit left." Verulam, with unknown resistance, if any, disappeared from the living world. London may have lingered on, having withstood the tide until about 585, as a mere paralyzed remnant of its former self, and the effect of its long resistance is shown in a curious prevalence of dark hair and complexion in the wedge of people behind it toward the midlands. Exeter, remote and conquered long after the conversion of the Saxons, was divided between the two races, who dwelt quite neighborly side by side.

For the conquest, though speedily effective over a large area, was, as a whole, the task of several centuries: and as we go westward the substitution of the invaders for the natives became less and less nearly complete. Indeed, it may be doubted whether it was really complete anywhere or at any time except in some very isolated, helpless and deeply hated neighborhoods.

A great rally of the Romano-Britons seems to have occurred in the first half of the sixth century, checking the conquest here, turning it back there and giving time on both sides for cooler thought, a better acquaintance with alien customs, a juster appreciation of enemies. The greatest names of this reaction are Aurelius Ambrosius and Arthur, the former very shadowy to us now, if remembered at all, but the favorite hero of Gildas and apparently of those Romano-British who were most proudly Roman; the latter, the human and efficient champion of the native or distinctively British party, but for many later centuries a monarch of myth and allegory and all emblazonings of poetic fancy. There is no need to go into the details of the various schemes which have been put forward as to his dozen campaigns and victories recorded by Nennius. They seem to have been widely spread, beginning in Lincolnshire near the east coast, including the far north and the far south and ending near Bath in a battle fought probably against Saxons who had passed in their small craft around Cornwall and come up the estuary of the Severn. As already stated, tradition gives him for capital Caerleon upon Usk, the great Roman legionary city for the Severn Valley and the west; but also another capital and stronghold normally nearer the West Saxon frontier, in Camelot, perhaps Queen Camel of Somerset.

It is apparent that the greatest slaughter generally fell upon the city folk and the dwellers in the richer and denser agricultural districts;

and that the most efficient and prolonged defense was made by those who were still hardy and little Romanized, the dwellers about the western foothills, the southwestern moors, the forest-folk, the fen-folk, the people in short who preserved most of the old Celtic and pre-Celtic blood.

It must not be supposed that the immigrants of the Roman-British centuries failed to leave any impress on the final constitution of the population; but it is apparent that the Saxon winnowing ensured in many places something like a reversion to Celtic or pre-Celtic types and ways.

During the welter of that age there was a very considerable reinforcement of Gaelic blood from Ireland, especially in North Wales and in Britain north of the wall, to most of which latter region it gave the name Scotland, strictly meaning the land of the Irish. The Gael of North Wales, both ancient and recent, were overwhelmed very shortly, however, by an eddy of Britons under Cunedda and his successors, who had found the Saxons too strong for them in the region about the Great Wall and fell on the Gael in retreating southwestward. Something like this must have taken place also in the long lower southwestern peninsula of Cornwall and Devon, where the traces of Gaelic occupancy are so plentiful and where the westward crowding of the Saxons on the steadily resisting and slowly retreating Britons was renewed at intervals until the ninth century.

We have, therefore, as a net result of the Saxon invasion and conquest, not only the total destruction of civilization in most parts of Britain and its gradual dwindling in others—but also the production in the eastern, southern and middle districts of a population rather largely, but not wholly, Saxon in the open country; farther west and in rugged places only a little Saxon on the surface, though often Saxon in speech; still farther west unreservedly British; and along the western shore partly Gaelic, though speaking British, now known as Welsh in its modern form. Ireland spoke Gaelic still—and seems to have remained as Celtic as before the Romans crossed the English channel, though there had been more or less trade between Ireland and Roman Britain.

In due time the Saxons, having been Christianized and mollified, began to work out in Britain a new civilization. It was very primitive and rudimentary compared with its Roman predecessor, but possessed elements of strength and hopefulness and aspired to a literature of its own.

Then the draught of barbarism which they had administered to the Roman-Britains in earlier times was held to their lips by those of kindred stock who had remained untaught in truly human things. The Danes and Northmen, during several centuries, ravaged the English coasts in the most pitiless manner (treating the Gael of Scotland and Ireland no better), marched their armies destructively through the

heart of the country, established themselves in great numbers at divers points and even seized the kingdom of England for a time and ruled the land. Sometimes they were beaten back with great losses, as by Alfred; sometimes they were slaughtered by the hatred of their Saxon neighbors, who rose against them. But they were not fundamentally very unlike some of these neighbors; so that the laws and customs of Saxon England may even be studied approximately in the more abundantly preserved Old Norse records, especially the Icelandic sagas. Indeed the Icelandic language, even to one who can not read it, displays a surprising number of words such as wharf, house, land, strand, which are still current among us. All told, the Scandinavian invasion chiefly affected the addition of a few words to provincial English speech and a reinforcement of the blond element in the people of northeastern England, with perhaps a slight increase there in stature and vigor.

Also the sea king inroads had driven the civilization of the island well toward the southwest, where it made a stand under Alfred, and eventually moved forward again.

Ireland, which neither Briton, Roman nor Saxon had reached, now experienced a real cataclysm from the Northmen, who broke up her very promising culture, laying waste the repositories of art and learning and making sad havoc of everything kindly and humane in life. The loss was felt very dreadfully for centuries and some features of it have never been repaired.

When at last the Danes were dislodged, England was no doubt more united and more advanced than at any earlier period since the Romans departed, and a steady gain continued under Anglo-Saxon rule, partly owing to abundant influences and immigration from the neighboring France and Normandy. But the dislodged Danes were persistent in trying to regain their seats, their very last effort—a strenuous and disastrous one—being directed against King Harold only a little before the arrival of William the Conquerer on the southern coast; so that the unhappy island hero had to hurry from his decisive victory at Stamford Bridge to his death in the ring of shields and battle axes on the crest of Senlac.

After that, the great Norman held the land too vigilantly and unflinchingly for any new invasion to be hopeful, so that the Danish episode in the life of Great Britain came to an end. It left the mountain people very nearly as the Saxons had left them, and in race at least practically little changed from even pre-Roman times: and the same was true, as in previous conquests, of many fen-lands, moorlands, forests and the like.

The Norman invasion was that of a tyrannical civilized people rather than of destroying barbarism. It came to Britain as to another Christian country under color of right, though a fraudulent color, and not in

open enmity of race or faith. Indeed, peaceful methods had already carried the conquest forward in some degree before it took on a military guise: consequently the people on both sides of the channel were again more or less alike in stock and culture. Their religious ideals and forms differed little and their political ideals were nearly allied, though perhaps the Saxon had a keener feeling for freedom—for his own freedom at any rate.

The Normans had begun as Norse vikings; but their long settled life among the French and habitual intermarrying had made them largely French in language and many things. On the other side the English had already borrowed many French words and some French ways, but still differed sufficiently to make a plain contrast between the two nations. The Norman despised and hated the Saxon as crudely boorish; the Saxon hated the Norman as aggressive, unrighteous, greedy and cruel, also despised him as vain, pretentious and given to making much of trivial things. Such inhumanity as was shown came from this clash of opinions, or the incidentally excited evil perversity of human nature, not from any settled purpose to destroy. Greed and policy, rather than wanton cruelty, were evidenced by the extensive confiscations of land or shifting of title and the many inflictions designed to keep down the vanquished. As we all know, the bitterness engendered by differences of custom, language and temperament, and much more by the oppression of the conquerers, died slowly away.

This Norman conquest, like most of its predecessors, proceeded from the southeast to the remoter quarters of Great Britain, but was very much more rapid than any other of like permanency. After the collapse of the main Saxon power below London, William still had to fight in the north before the gates of York and in the far west about the walls of Exeter; also, longer and harder than almost anywhere else, amid the marshes of Cambridgeshire, where Hereward, the persistent partizan leader, had established on the Isle of Ely his city of refuge. But there was no immediate conquest of the Welsh mountains or Ireland, though both were penetrated later, with great suffering to the natives and every kind of wastefulness. The highlands of Scotland remained Gaelic in tongue; Wales and Cornwall with some bordering territory retained their British speech and the changes of their population were very slight at first and probably only moderate afterward.

In the main body of England there were developments of language rather than linguistic revolution, a great extension of the English vocabulary by French and Latin words, chiefly introduced to answer new needs, and certain innovations in forms of speech, some of which (such as double negatives) have been only temporary in good usage; but the general character and type of the language remains unchanged.

As to racial modifications we can be even less certain than in some

earlier instances of invasion, for the conquerers themselves were very complex. They contained Germanic and Celtic elements and drew recruits from the unlatinized or delatinized Bretons no less than from the at least superficially Latinized French and peoples farther afield. It is becoming also increasingly probable that, under all these, a substratum of still older submerged races supplied and still supplies the greater and more enduring mass of the French people. Allowing for the considerable amount of Scandinavian blood among King William's Normans, it seems altogether likely that this conquest did not greatly vary the racial composition of the island people, setting minor distinctions aside. That on the whole it tended rather toward darkening the English race than lightening it in complexion may be plausibly argued from the great number of adherents which Brittany, next neighbor of Normandy, had supplied the Conquerer both before and after the invasion; also perhaps from the special favor which was soon extended to the British-speaking natives of the island, so long as they refrained from revolt. There was at least a precarious basis of good will in a common enmity for the Saxon. The Norman court and aristocracy readily seized on the historic legend of King Arthur, the Champion of Britain against Saxon invasion, and wove the most remarkable tissue of romance about it which the world has ever seen. This made unquestionably for Celtic prosperity, multiplication and immigration. But the Celt at that time as now, wherever found, was less often blond than dark, less Celtic in aspect than pre-Celtic. So that type was at least not appreciably diminished by the Norman invasion.

In later years there have been no more waves of conquest rolling over the lowlands of Britain though there have been wars and reformations and revolutions, changing many things. As a net result, ethnologically speaking, the Gael have been pushed farther back into the northern mountains and have lost some ground in Ireland in favor of more or less Saxon and Norman invaders. On the other hand, they have peacefully invaded the English and Scotch cities and many country districts, more than compensating for any partial extirpation of their stock in seats formerly held along the western coast of Britain. There have been other immigrations and shiftings of population from time to time, but nothing that should appreciably change the racial map of that island, though the linguistic map as stated would show a progressive shrinking of the Welsh and Gaelic areas; at least until quite recent years, when special influences of expansion began to work in both cases, with doubtful final outcome.

My general conclusions are, therefore, that the racial composition of the people of Great Britain has been but moderately affected by conquests and other events occurring since the sixth century; that from a period antedating all history one of its most permanently important

racial elements has been a dark-haired neolithic race, of which we know very litle indeed; that in the far north and in most parts of Ireland the Gaelic Celtic race is next important and measurably supplies language; that in the west of Britain the Welsh, or British Celtic, race takes its place, though accompanied by notable Gaelic and Saxon and some Norman elements; that the originally Teutonic races, Anglo-Saxons, Danes, Northmen and Normans, now pretty well blended everywhere and only locally and doubtfully distinguishable, are conspicuous in the lowlands of Scotland, the northeast of Ireland and most of the eastern and southern lowlands of England, being in the majority in a few districts and supplying the exclusive language of both islands, except in the restricted Welsh and Gaelic areas. In Great Britain at least they have attained and held a general political supremacy, though with important exceptions, and have contributed perhaps rather more than their full share to the various activities of the island. But as their language is blended of materials from many sources woven on a low German framework, so their race is blended of constituents from many immigrations and conquests filled into a framework that is neither Saxon nor Celtic, but perhaps mainly pre-Celtic, whatever that may be.

BATTLES AND RAINFALL

By ALEXANDER McADIE

A. LAWRENCE ROTCH PROFESSOR OF METEOROLOGY, HARVARD UNIVERSITY

"DO battles cause heavy rains?" This question is being frequently asked by many who ordinarily are not disposed to readily accept the view that such a relation exists. Their skepticism has been somewhat shaken by the fact that battles probably the noisiest and bloodiest in history are in progress and coincidently heavy rainfalls have occurred near the battle territory and elsewhere.

The explanation which first suggests itself is that concussion due to cannonading has shaken down the raindrops. But there is no physical process known that directly connects rainfall and concussion as effect and cause and physicists unanimously agree that such a relation seems improbable. The first definite objection is that the air and water-vapor are not themselves transported by an explosion or any violent agitation like that due to gunfire. There is no transference of the medium itself any more than in the case of a sound wave. Waves of compression and rarefaction are in the nature of a progressive pushing and pulling, each molecule pushing its neighbor a short distance forward and then pulling it back. To make it still more plain, the air disturbance would be like those compressional waves in the earth's crust which every earthquake starts and which are recorded on seismographs.

The most violent explosion in air, therefore, would not remove any appreciable volume of air and vapor from one locality to another, while it would cause a pressure wave, and as in the case of great volcanic eruptions like Krakatoa, Mount Pelée and Katmai, a wave of sufficient intensity to be noted at observatories around the world. Such a wave encircles the globe in a few hours, and so far as we know has no effect in causing rain. But, on the other hand, it is true that in all great volcanic eruptions large quantities of dust particles (dust is the general name for all nuclei in the air) are injected into the higher air currents and carried from place to place. These do play a part in facilitating condensation and consequent precipitation. Krakatoa dust encircled the world in fifteen days and eventually probably caused excess rain in some localities. In this indirect way, rather than through concussion, it is conceivable that rain and explosions may be connected. But a volcanic eruption far exceeds in violence gunfire, even that of the greatest battles in modern warfare, and there is a vast difference between the gases generated and other output. The eruptions at Katmai,

Taal, Asama Yama, Bandai San, Tarawera, Mount Pelée, the Soufrière of St. Vincent, Krakatoa, and even little Lassen, emitted enormous volumes of gas, fine ash and coarser matter. At Katmai, for example, the output was so great that the deposit at Kadiak 121 kilometers distant (75 miles) amounted to 35 centimeters (14 inches) of fine granules of sand, orange and yellow dust and pumice. Again, the intensities of the air shock, if we may so express it, are very different in eruptions and battles. Tornadic inrushes occur near the volcano and for some distance; while the wind rush of the largest gun when fired is hardly different from that of a passing train. A crude comparison of these relative intensities may be gleaned from a note made by Omori, the foremost seismologist of Japan, to the effect that during the Asama Yama eruption (December 7, 1909), there were marked pressure changes on nearly all the barographs in Japan and to a distance of 160 kilometers (100 miles), while in the city of Tokio, the daily noon gun fired close to the Central Meteorological Office never affects the instruments there. At Blue Hill Observatory, we have never been able to detect changes due to the firing of the big coast guns, or those of the fleet when manœuvring.

It, therefore, seems but fair to conclude that to cause rain, gunfire would have to be on a vastly greater scale than is at present the case. And, as for the attempts which have been made to produce rain by bombarding the clouds, it is enough to say that the claims and statements made by the experimenters, or shall we call them exploiters, are not supported by the facts.

Some years ago at Santa Barbara, during a prolonged dry spell, a meeting of the citizens was called to consider an offer from a temporary resident, a Michigan millionaire, to furnish all explosives needed to produce rain. This gentleman claimed to have successfully caused rain by these means on his ranch in Texas, during cloudy, threatening weather. While the meeting was in progress, rain began to fall and there was no further interest in explosives. This incident is referred to here because if the meeting had been held a day or two earlier, and the proposal accepted and the firing begun, it would have been extremely difficult to convince the people of that section that the rain was not directly connected with the firing. Men's ideas of the nature of the atmosphere are still very vague, and with this indefiniteness goes a corresponding readiness to draw conclusions from insufficient data. Sir William Ramsay has pointed out somewhere that the discovery of the true nature of air was held back for years because of erroneous ideas regarding combustion.

We may then dismiss the attempts of the American rain-makers and also the hail-shooters in Europe as inconclusive. There is no reliable evidence that such efforts have caused rain or any increase in the rain-

fall. Nor is it established that rain follows heavy battles and excessive firing. Records properly assembled disprove the existence of any positive relation between concussion and rainfall.

Still, it would be unwise to assert that our knowledge of the formation of rain and particularly the structure of a raindrop is such as to enable one to say that rain production is beyond the power of man. Furthermore, much that appeared to be fundamental and basic in physics, a few years ago, has now gone by the board or been so modified that the physicist is, to speak frankly, at sea regarding the structure of the atom and the nature of action at a distance. We know very little about the behavior of the large ions in air, also the small and intermediate ones, and their respective mobilities. In fact, we can only surmise as to the rôles played by these molecular clusters in actively assisting condensation and precipitation. We know that if the nuclei are filtered from air, condensation even with saturation is very slow. We also know that some of the nuclei are electrified but the great majority are not. There appears to be an intermediate state between gas and liquid. Through the investigations of Aitken, Wilson, Thomson, Barus, Langevin, Pollock and others, we picture the large ion as a nucleus on which water molecules are adsorbed (not absorbed), the extent depending upon the vapor pressure, and the whole being electrified by the small ion. We have been taught to believe that cloud formation is a physical process in which the effective factor is cooling. The cooling may be brought about by elevation, radiation, contact or conduction and mixture or convection, yet we may not shut our eyes to the possibility of electrical action in controlling the combination or agglomeration of minute particles. Just how this would take place or just how the raindrop and snowflake are built up is not yet known, nor how the process can be accelerated or retarded. Indeed if this were known, man would be nigh unto control of the rain, or at least have in his hands rudimentary means for compelling or preventing precipitation. Job's query which has remained so long unanswerable

Who shall number the clouds, who shall stay the bottles of Heaven?

would be less of a poser. Stranger things have happened than that man should find a way to master the water vapor in the free air; and, for example, to dissipate the clouds and fogs. To make a commercial success of the process, however, would be another story.

Finally, it may well be asked if battles do not cause these abnormal rainfals, what does cause them; and why are some seasons so entirely unlike others? The best answer available at present, though by no means an assured explanation, is that the circulation of the lower air varies in different seasons; and this circulation is controlled by certain "low" and "high" pressure areas. The probability of this relation

was first pointed out by a Frenchman of Scotch descent, M. Leon Teisserenc de Bort, the investigator who with his colleague, the late Professor Lawrence Rotch, did so much to add to our knowledge of the upper air; and in fact discovered the stratosphere. He was seeking for the explanation of certain cold spring months in the very region in which the war is now raging. Other meteorologists have carried the work further and we now think we know the cause of late springs and early springs on the Atlantic coast. There appears to be firm ground for asserting that when a marked hyperbar or excess of pressure overlies the northwest Atlantic, persisting for a week, a fortnight or even a month, the surface flow of air or winds will be mostly northeast and of moderate intensity. Such winds carry large volumes of water vapor and unless the land temperatures are high, the result is foggy, cloudy weather along the shore from Maine to New Jersey. This makes for a relatively late spring and cool summer, on the one hand, and a relatively warm winter, on the other. Similarly on the Pacific coast, it has been shown by the writer in his "Rainfall of California" that dry periods in the winter, which is normally a wet season, and wet periods in the early summer, which is normally a dry time, are directly associated with the location of certain hyperbars and infrabars. Just what are the determining causes in building up these centers of action the meteorologist can not yet say; and hence no accurate seasonal forecasts are possible. Weekly forecasts are indeed attempted by the Weather Bureaus of this and other countries; but, it may be frankly admitted, with only partial success. Still a beginning has been made and there is no doubt in the mind of the writer but that discoveries will be made and improvement follow.

SOME PHENOMENA OF FLUID MOTION AND THE CURVED FLIGHT OF A BASE BALL

By Professor W. S. FRANKLIN

IT is widely believed that a descriptive science like botany is fundamentally and essentially different from a mathematical science like physics. The one certainly does contain all that is vital in art in its sympathy with observed life and its interest in natural form as of leaf and flower; whereas the other is usually thought of as the negation of art in its interest in dead material and its dependence upon the highly conventional and abstract forms of algebra. This point of view was generally held even among scientific men half a century ago, but it is now relegated to that overflowing museum of caricatures, which it seems to be the chief function of the old-fashioned classifying philosophy to fill.

All science is descriptive. The object of this paper is to illustrate a descriptive phase of physical science, and the paper is put into the form of picture-and-legend to emphasize its descriptive character. The paper is incomplete, however, in one respect, namely, in respect to How much? How far? How long? Indeed it is in connection with this quantitative aspect of physical science that algebra is mostly used, and it is here that the essentially descriptive character of the science is nearly lost sight of. There is, however, something essentially descriptive in the use of algebra honestly according to what may be called the Maxwellian method, where algebraic forms spring full-fledged and rich from highly elaborated physical ideas, and there is little besides humbug in the method so elegantly employed by Ampère and so often employed by others where the natural path to a discovery is obliterated and replaced by elaborate algebraic synthesis *after the discovery has been made.*

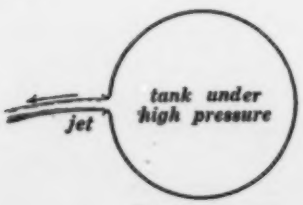


Fig. 1.

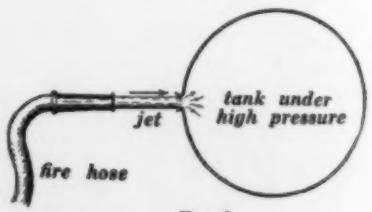


Fig. 2.

In the tank the water has a high pressure and low velocity, and in the jet the water has low pressure and high velocity. Fig. 2 represents a fancy method for pumping water into a steam boiler; namely, by squirting a jet of water at a hole in the side of the boiler.

The steady curvature of path of a rapidly spinning baseball is explained on the basis of a principle which was first enunciated by Daniel Bernoulli in 1726. Bernoulli's principle is illustrated in Figs. 1 and 2. *In a stream of water or air the pressure is high where the velocity is low, and the pressure is low where the velocity is high.* There are certain limitations to this principle which need not be discussed here.

Air flows through a tube *CD*. Where the section of the tube is small, at *a*, the velocity of the air is large; and where the section of the tube is large, at *b*, the velocity of the air is small, as indicated by the two letters *V* and *v*. Furthermore where the velocity is large the pressure is small and where the velocity is small the pressure is large, as indicated by the two letters *p* and *P*. The low pressure of the air at *a* draws the liquid up in the tube *T*, and the large pressure of the air at *b* pushes the liquid down in Tube *T'*.

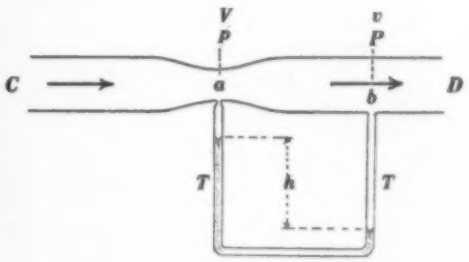


FIG. 3.

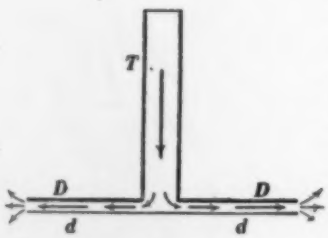


FIG. 4.

A brass tube *T* is soldered to a brass disk *DD*, and air is blown through the tube *T* and against the loose disk *dd*. The air between the two disks has a large velocity, but this velocity decreases greatly towards the edges of the disks because of the great increase of the sectional area of the air stream, and it decreases still more as the air (by virtue of its momentum) pushes itself out between the edges of the disks into the surrounding air. Now the pressure of the surrounding air (where the velocity is low) is high, and the pressure of the air between the disks (where the velocity is high) is low. Therefore the surrounding air exerts greater force in pushing the disks together than the force exerted by the air stream in pushing the disks apart. That is, the disk *dd* sticks tighter and tighter to *DD* the harder one blows through *T*.

This represents a hydraulic analogue of Fig. 4. The rapidly moving water on the disk is at a low level, and it lifts itself to the higher level of the still water in the basin as it flows off the edge of the disk *dd*. Therefore the still water underneath the disk has a higher pressure than the moving water on top of the disk so that the disk is held up. The pin *p* serves to prevent the disk from moving sidewise.

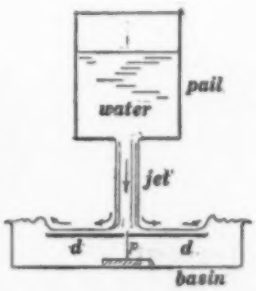


FIG. 5.

This shows a light ball floating in an air jet. The air in the jet pushes up on the ball and keeps it from falling, and when the ball starts to fall out of the jet the surrounding air pushes it back into the jet because the pressure of the surrounding air is high (where the velocity of the air is low) and the pressure of the air in the jet is low (where the velocity is high).

FIG. 6.

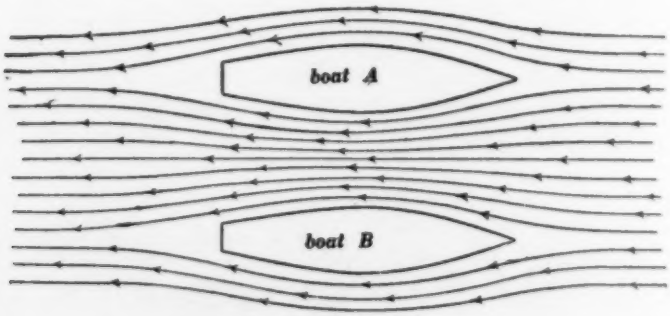


FIG. 7.

This represents two boats moving along side by side in still water, or what amounts to the same thing, two boats standing side by side with water flowing past them. The stream is greatly compressed in the region between the boats, and the velocity in that region is high, higher indeed than it is on the outside of either boat. Therefore the water level (which corresponds to pressure) is lower between the boats than it is on the outside of either boat, and the higher water on the outside of the boats pushes the boats together. It is a well known fact among navy men that two boats which are steaming along side by side are powerfully drawn towards each other.

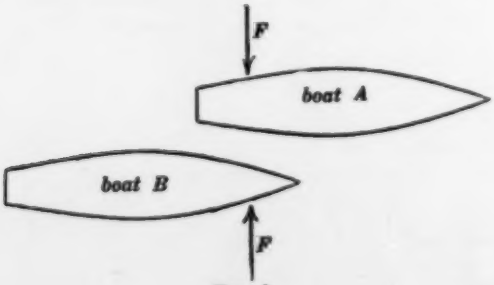


FIG. 8.

The most serious condition which can arise when one boat is steaming past another is shown in this figure. The two forces *FF* with which the boats are pushed towards each other tend to turn the boats, thus the boat *B* is powerfully turned towards boat *A*, and a collision is almost sure to take place before the rudder can be properly set to keep the boat from turning.

The effect which is described in connection with Figs. 7 and 8 may be shown by blowing between two light rubber balls which are suspended as here shown. When one blows between the balls the balls come together with a bump.

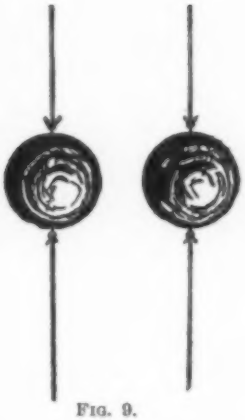


FIG. 9.

The following four figures lead up to an understanding of the curved flight of a spinning baseball, and Figs. 10, 11 and 12 must be thought of together.

FIG. 10.

This figure shows the whirling motion of the air in the neighborhood of a spinning ball.

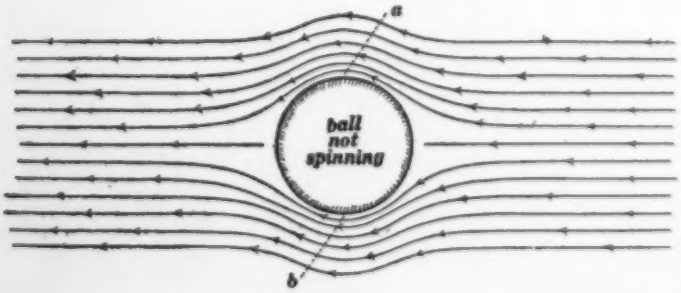


FIG. 11.

This figure shows the motion of an air stream flowing past a ball which is not spinning. The stream splits and flows equally around the two sides of the ball.

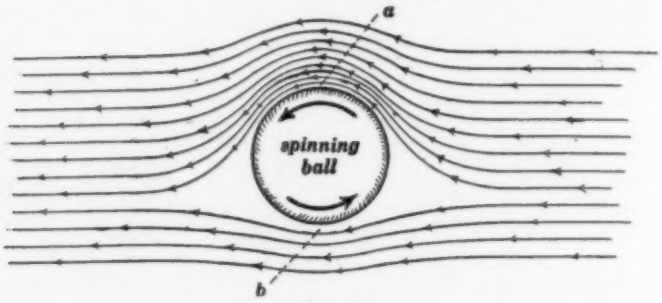


FIG. 12.

This figure shows the motion of an air stream as it flows past a spinning ball. The velocity of the air at the point *a* is partly due to the spinning motion of the ball as shown in Fig. 10, and partly due to the stream as shown in Fig. 11. That is, the two causes which are shown in Figs. 10 and 11 act together to produce a large velocity at *a*, and the two causes which are shown in Figs. 10 and 11 oppose each other and produce a small velocity at *b*. Therefore the velocity is large at *a* and small at *b*, and consequently the pressure is large at *b* and small at *a*. The air at *a* therefore pushes down on the ball with a small force *f*, and the air at *b* pushes up on the ball with a large force *F* as shown in Fig. 13.

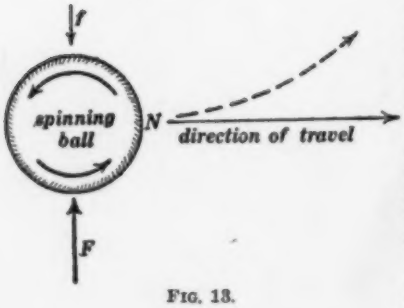


FIG. 13.

The action in Fig. 12, where a stream of air flows past a spinning ball, is exactly the same as the action which takes place when a spinning ball travels forwards through still air, as shown in this figure. A large force *F* pushes up on the spinning ball, and a small force *f* pushes down on the spinning ball. Therefore the ball curves upwards as shown by the dotted arrow. Of course the upward force *F* must be much greater than the downward force *f* to produce an upward curvature, because the downward pull of gravity on the ball must be overcome.

The point *N* on the ball may be called the *nose of the ball*. This nose is traveling sidewise because of the spin of the ball; and the ball curves towards the side towards which the nose of the ball is traveling.

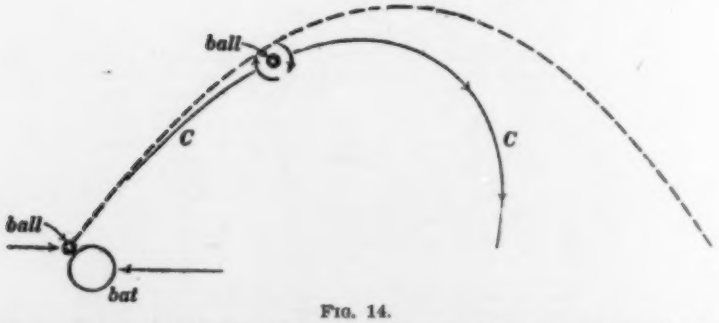


FIG. 14.

The curve *CC* shows the path of a high foul. The ball strikes the bat and is set spinning in the direction shown by the small curved arrows. If the ball were not spinning it would follow the dotted line, but the spinning of the ball causes it to be deflected continually to one side, as explained in connection with Fig. 13, so that the ball actually follows the path *CC*.

A ping pong ball is thrown upwards by shooting it with the thumb, marble-fashion, so that the ball is set spinning in the direction of the curved arrows. The dotted line shows the path which would be followed by the ball if it were not spinning, and the full line shows the actual path of the ball.

FIG. 15.

THE SPIT BALL

Imagine a perfectly smooth ball traveling through still air. There is certainly no reason why the ball should be pushed to one side rather than the other; therefore one may conclude that the ball will not be pushed to either side! In the same way there is no reason why a sharp-pointed stick standing exactly vertical on a hard floor in a quiet room should fall one way rather than another; therefore we may conclude that the stick will not fall either way! This is good logic in both cases, but it is bad physics. The ball *is* pushed to one side or the other, and the stick always *does* fall. The vertical stick is in what is called an unstable state, and an infinitesimal disturbance is enough to start the fall in some direction, and then away she goes! Also the motion of a smooth ball through still air involves a condition of instability, and an infinitesimal disturbance is enough to start an action which rapidly develops and pushes the ball decidedly to one side or the other.

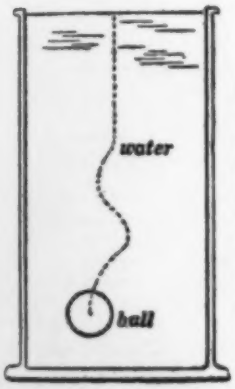


FIG. 16.

This shows the irregular zig-zag path of a smooth ball (not spinning) as it sinks in water. The ball travels nearly straight until it attains a certain velocity, and then it follows a zig-zag path until it reaches the bottom of the vessel. A smooth ball (not spinning) also describes an irregular zig-zag path as it travels through the air, but the irregularities are much less than in the case of a ball moving through water because the density of the air is so small as compared with the density of water. The cause of this irregular zig-zag motion is analyzed in the following figures.

FIG. 17.

Every one is familiar with the peculiar curling motion of a rising streak of cigar smoke in still air. The first part of the stream is smooth, but as the velocity of the rising smoke increases, the stream becomes unstable and develops into a complicated set of eddies and whirls. The boundary between a rapidly moving stream of air or liquid and a stationary body of air or liquid is unstable, especially if the velocity of the stream is great; and this instability always shows itself by the development of a complicated set of eddies and whirls.

When a gas jet is not turned up too high, the velocity of the gas in the jet is low and the stream of gas is smooth as shown by the sketch *a*. If the jet is turned up too high, however, it becomes very turbulent (full of eddies and whirls) as shown by sketch *b*, and in this case the flame produces a roaring sound. The loud hissing sound of a steam jet is due to the extremely fine-grained eddies and whirls which are formed along the boundary between the rapidly moving steam and the adjoining still air.

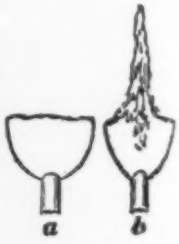


FIG. 18.

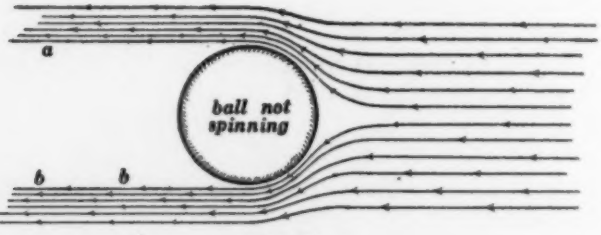


FIG. 19.

This figure shows a stream of air moving past a ball which is not spinning, the velocity of the stream being rapid so that the stream breaks away from the ball as shown, giving two boundaries *aa* and *bb* between rapidly moving air and stationary air. Such boundaries are unstable as exemplified by the behavior of the smoke jet in Fig. 17 and the gas jet in Fig. 18. Therefore eddies and whirls develop along *aa* and *bb*, and as a result the stream at *aa* will be at one instant deflected downwards (in the figure) and at another instant upwards. The same thing may be said of the boundary *bb*. Whenever the stream at *aa* (or *bb*) is deflected downwards (in the figure) a force of reaction is brought to bear upon the ball pushing it upwards (in the figure), and whenever the stream at *aa* (or *bb*) is deflected upwards a reacting force is exerted on the ball, pushing it downwards. Therefore the ball is pushed irregularly to one side and the other repeatedly. The action here described refers to a stationary ball with air flowing past it, and exactly the same effects are produced when a ball moves swiftly through stationary air or water, and the irregular side forces which are exerted on the ball cause it to describe a zig-zag path.

HUNGER AND FOOD

By Professor GEORGE J. PEIRCE
STANFORD UNIVERSITY

THE most important chemical change taking place in all nature, at least as far as living beings are concerned, is the combination of carbon-dioxide gas and water into food. Going on under our very eyes, in every green leaf in the sunlight, this chemical process converts a useless constituent of the atmosphere into sugar by combining its component atoms with those of water. From the sugar are built up all the other foods of all plants and all animals. The details of this chemical change are only partly known, the intermediate stages have so far escaped the most acute research; but we know the raw materials and the products; the energy used in effecting the change; the means of absorbing this energy; and the place where it is applied. The energy is light rays of certain wave-length; the absorbing screen is leaf-green, chlorophyll; the place of application is the green cells of plants. The raw materials are the most universally distributed substances in nature—carbon-dioxide, occurring in the atmosphere to approximately .02 per cent., and water, occurring in the amounts which we, living in this semi-arid region, realize much more accurately than our fellows in those parts of the "temperate" zone where life is maintained only with difficulty, through summer as well as winter, because of climatic violence.

The daily transformation of enormous multiples of six molecules of CO_2 and six molecules of water into single molecules of sugar, accomplished in weed and grain and tree, results, in the course of a single growing season, in harvests of astonishing values. The values of the crops of the United States in recent years, so far as available reports show, are as follows: cereals ('11) $4,280,205,000; cotton ('11) $8,125,140,000; forest products $195,306,283; fruits $76,709,195; hay ('11) $784,926,000; honey $5,992,083; orchard products $140,867,347; peaches and nectarines $28,781,078; peanuts $18,271,929; plums and prunes $10,299,495; potatoes $233,778,000; tobacco $85,210,387; vegetables $209,548,021; wool $75,879,251—a total of $14,269,854,069 for the farm products of the United States alone in a single year.

To this huge sum must be added the value of all the various forms of live-stock raised during the same year, $5,296,421,619; for the subsistence of these flocks and herds and bands is the product of the same chemical changes, the combination of CO_2 and H_2O into food. Every article of human consumption and use which is not mineral owes its existence to the same source of food. Is it any wonder, therefore, that

I have called this the most important chemical change in all nature? But is it any great wonder that a botanist, entirely ignorant of economic theory, should be led, by his reflections on this important phenomenon, to enquire into some of the relations of man to food production. I make no claim of novelty in point of view, of freshness of material, of the discovery of new facts, but nevertheless I should like to share my reflections on hunger and the means of meeting it?

Looking over this list of commodities of plant and animal origin, we find some which must be called absolutely indispensable, whilst many others, commonly spoken of as necessaries of life, would not be proved by experience to be more than comforts. Clothing, shelter and all the numerous articles of pleasure, from violins to tooth brushes, man could do without, but food and drink he must have. Of what man eats much is unnecessary, either in kind or amount. To the bare subsistence of humanity a minimum ration of protein and carbohydrate is absolutely indispensable. What this minimum ration is does not matter: but what does matter is that so few individuals, so few communities, so few nations even, produce it. This is the peril that many have seen—a succession of seers not without honor, and ridicule, through the ages—it is a peril which varies in gravity according as the balance varies between production and consumption.

The war has exposed to all the world that certain of its great nations are not self-supporting. To those of us who live in parasitic comfort, the idea of self-support is of theoretical interest only, a moral ideal which may have been taught us but the enforcement of which was left to circumstances. Until division of labor began to be generally practised, self-support was not merely an ideal, it was a necessity. Self-support is still necessary among pioneers; but in established communities division of labor has made a decreasing fraction of the population self-sustaining. Division of labor and specialization, resulting in the more rapid and more perfect performance of certain actions or functions, benefit the community and the state by the increased quantity and improved quality of the product. But this benefit has its disadvantages also, for the benefit is accompanied by risk. On the frontiers of civilization the individual must be self-supporting or die. A later development is the self-supporting community. Such the New England farming community used to be. With the completion of the New England adage, "God made the country, and man made the town, and the Devil made the small country town" came also the beginning, in this country, of those larger communities which were less and less able to support themselves as they grew larger, more influential and more prosperous. What sort of prosperity is it, however, that can not feed itself, clothe and shelter itself, that has to be served with every necessity as well as every luxury? And what a topsy-turvy world we live in, when the acme of prosperity

is the maximum of dependence, and complete parasitism is the admired ideal of civilization! The development of civilization, with its continued adherence to the moral ideal of self-support, has seen larger and larger social units excused from attaining it. Have we gone far enough, or for the time being at least perhaps too far, in this direction? This question will be answered variously according to age, occupation and imagination. But each can realize that his answer will be a resultant, a compromise, of contradictions. Individualist and socialist, competitor and cooperator, idealist and reactionary, are side by side within each one of us. Each of us adjusts his life as he may, circumstances and will determining what we do and are, with conscience calmed by the ethics of our particular occupation.

It sometimes happens, in the life of a college officer, that he is invited to speak to another audience than the one which seeks him regularly for leading in the special path which is his life-interest. Sometimes he is talked to as an elder brother by those with whom he has become friends. Such opportunities are rare. They are correspondingly precious. They must be met by clear sight and honest thinking, to be realized at all. In such instances, what do we say or do?

With an increasing population, guaranteed in times of peace a longer span of life through the development of medicine, surgery and preventive medicine, with increasing urban populations, increasing disproportion between parasitic and self-supporting human beings, decreasing areas still untilled, and decreasing production on too large a proportion of the cultivated areas, is it not wise to question whether the world's condition is altogether safe? The economist may say that the law of supply and demand will control. Doubtless it will and does, in the long run; but if the supply lag behind the demand, who will suffer? There is no question of the demand for food; but because its production is possible so far only in the course of a season's growth, by means of that chemical process which combines CO_2 and H_2O, not by manufacture, the supply may lag months behind the demand. If the season be bad or the laborers, the producers, too few, the supply will lag still longer. What can trade, or the practise of the professions, do to supply food, actual food, to even the minimum ration of protein and carbohydrate required by every human being to sustain life? The most intelligent, if not always the most energetic, young people of the civilized world seek to attend the colleges. There they are led along the ways of parasitism and away from self-support, trained for trade, for the professions, and, in the case of young women, for attaining an *ad interim* livelihood by teaching the children of others in the elements of knowledge.

I am not implying the desirability of converting our colleges into "cow-colleges," but I am advocating the serious reflection of old and young upon the question of continuing and increasing the world's supply

of food. Some of our students, perhaps most obviously in the biological courses, are wondering how they can put their training to best use. When I told a young man, some years ago, who was paying his way through Stanford by producing and selling milk, that he would be a more useful citizen if he gave up his idea of becoming a teacher and devoted himself to the calling for which he showed evident aptitude, I was pleased that he followed my suggestion and went into the dairy business. But he didn't *fit* himself for it; he developed an inflated business, and presently went on the road to sell stoves! The fate of his milk business you can guess.

Some of my friends have sons interested in agriculture. One of them says he has told his son that it is not open to him, for he has no capital to start on. Is the practise of agriculture open only to the capitalistic class? Our immigrants do not think so, nor do the real-estate operators so assert; and the increasing comfort year by year of the farmers of the country, starting on leased or on government land, working at first or always with their bodies as well as their brains, attest both the ability of the man without capital to win for himself a livelihood and the satisfaction of serving his country well.

Because of the remarkable qualities of their sunshine, temperatures, and soil, California and the Pacific coast have seen the development of specialized farming on an unprecedented scale. The result is full of danger. The war has closed the European apple market, and we all were able to buy apples for about half the cost of last year. The citrus market is one peculiarly sensitive to unfavorable financial conditions. Fruit is abundant here, but only the fanatical would think of living exclusively on fruits and nuts. The price of bread has risen in many other places than Berlin, despite the bumper crops of California, Utah, and other grain-growing states. Potatoes are an uncertain commodity to buy. There has been no corner, no artificial rise in potato prices here this year; but good potatoes are not as abundant as good oranges, though on the whole more nourishing and more necessary. The price of meat is said to be no higher than a year ago, but a part at least of the European market has gone for the time, perhaps for a long time, because the money to buy meat has been spent on ammunition.

I can not feel that scanning the market columns in the trade and daily papers serves any other purpose than to inform us of what is. The country, intelligent people, must look as far ahead as they can. What the world needs and will always need is food, producers of food, and distributors of food. The man who, though not a farmer, can help the farmer in any way, will always be useful. And that man, that community, that state, which is best able to feed itself, will be the safest. Of the nations now at war, one is safe, Russia. Hungary is safer than Austria, France is safer by far than England, Germany's plight may be

made light of by its partisans to-day, but the prosperity of empires founded mainly on manufacture and trade is at best insecure. To my mind, one of the greatest lessons of the times is the wisdom of self-support. It is more than a moral ideal: it is common sense, the expression of stern necessity.

The development of manufacture is commonly desired by the community and the state. Manufacture implies raw material. Raw material comes either from the accumulation of ages in mine and forest, or from the yearly product of plant chemistry. In so far as manufacture consists in the rapid treatment of the accumulations of ages, it may arouse the opposition of the conservationists, who meanwhile are enjoying the results. But in so far as it consists in the treatment of the year's harvest, it must be supported by more than the granting of mill-sites, tax exemption, and boom "literature." It too needs the producer, for it is not self-supporting. It is a trite saying that agriculture is the basis of prosperity. Without agriculture, the artificial stimulation of natural production, the top-heavy animal kingdom would be doomed. Consider what has been accomplished since the pilgrims first landed at Plymouth, the first settlers at Jamestown, the Padres in San Diego! The established balance of nature on the continent of North America has been completely destroyed. In place of the large population of forest and prairie plants, of game and other wild animals in large numbers, and a comparatively small number of human beings, there have come millions of people, the extinction of certain animals, the destruction of forests and of the plant cover which held the soil and kept the streams clear. There has been great increase in the production of food, both plant and animal, but that the proportional increase in the production of food has been maintained, or is being maintained, is doubtful. Who is to continue production so that it shall be proportional to consumption? The law of supply and demand? If so, then some must be hungry before it will be so plainly profitable that even the dull will see that we must produce more per acre, more wheat, corn, alfalfa, oats, barley, rye, more meat. The securest livelihood may be obtained by meeting the largest and most constant demand. That demand is for food. The supply is for us to furnish, to advocate, to aid, and to consume.

The thesis which I have thus advocated is so reasonable—and so obvious—that there must be weighty objections else the American would not have been converted from sturdy farmer into nervous business man in so short a space of time. A friend once defined "good times" as those in which "a large stream of money flows through one's pocket." Here is at once a difference between farm and city. The farmer is not paid off Saturday night. There is no stream of money flowing through his pocket. He may have a large sum in his pocket at one time, but he is

quite as likely to have as little as a professor at another. But it is not necessary for me to discuss the matter of payments to and by the farmer; nor those matters, inside and outside the farmhouse which have occupied the Country Life Commission, with results which have so far escaped my knowledge. On the other hand, there are certain changes in the hazards of crop production which fall more properly within the field of the biologist. Farming is actually not as easy as it used to be, though perhaps it is less laborious. There are more enemies to the crop than there used to be. These enemies are of two main sorts, living and lifeless: some are aerial, some terrestrial; some are seasonal and temporary, some are constant and cumulative. Yet these enemies are conquerable.

Complaint is made, in various parts of the country, that there is a decline in the fertility of the soil, that the soil is becoming "exhausted" by continued cropping. When the blame can be properly fixed on the soil itself, and not on faulty or no selection of seed, neglect in the sterilization of seed, neglect or ill-luck in the destruction of seed or seedlings by birds, gophers and other habitual vegetarians, it is generally found that neglect of some other sort explains the situation. The disc harrow instead of the deep plow, the filthy barn yard instead of well-manured fields, a change or no change of crops instead of crop rotation, and summer fallow instead of alternating grain and leguminous crops, these are some of the forms of neglect which I think I recognize.

If we speak of soil exhaustion now-a-days, we do not mean the actual depletion of the potassium and other salts, the sulphates, phosphates, nitrates; for no soil is so impoverished or so sterile as to lack these constituents completely, or even in such degree that they do not exceed the concentrations in the nutrient solutions commonly used in the laboratory with entire success. Ordinarily an exhausted soil is one in which plant excreta, by reason of faulty cultivation, have been allowed to accumulate. Sunning, airing, washing are the effective ways of cleaning soil as well as other things; but just as we may get the smell of tobacco smoke out of our clothes by walking them home, or otherwise using them in the open air, as well as by hanging them on the line, so soils can be cleansed at the same time that they are being used, if only the use be appropriate. This is crop rotation, an obviously more economical method than that of summer fallow, against which all nature rebels, but which is strangely popular in the west.

Important as the soil is—for no living organism can live without a minimum of mineral matter—I can not help feeling that the differences in the productiveness of great areas may be due to some other and more general cause than soil or season. The experiments of Klebs, Vöchting and others in the comparatively opaque atmosphere of Germany, the observations of Delpino in the clearer air of Italy, the records of John Muir and the impressions of all of us in California, and the work now

being done in the Carnegie Desert Laboratory at Tucson, Arizona, show that what we call fertility, attributing this to the soil, may after all be fecundity, a result to which light contributes at least as much as the soil. We may have luxuriant vegetative growth and no seed in rich but shaded soil; we do have scantier vegetative growth but abundant seeding in poor but brightly lighted spots. The development of the reproductive organs, the opening of the flowers, is one of the effects of light. Just as the light causes the orange yellow poppy blooms or the majenta corollas of Red Maids to open, so it is the light which stimulates the plants to form the blooms at all. And as we have more light in California than in many other parts of the world, so also we have richer and hence more stimulating light. The part played by richer light in the greater productiveness of certain large areas as compared with others will be more fully recognized presently than now. We should speak of fertile light and fertile air, if we are to recognize its importance as truthfully as we do that of the soil. And in selecting places for producing food, the world and its citizens will do well to take light as well as soil into account. The further study of light in relation to reproduction, to the setting of seed and fruit, and to the production of crop, will enable the world to increase its food supply without necessarily increasing its acreage.

Anything which disturbs the balance of nature releases forces, living and lifeless, which hitherto had been held in check. The complete change on the American Continent from a state of balance in the then wild nature to the present condition of cultivation, extending further and further into the wilderness, has resulted in so changing the conditions of existence that man and his parasites have enormously increased in numbers and the plants which he cultivates have been greatly multiplied and extended along with their insect, fungous and bacterial enemies. To meet this latter condition a profession is coming into existence similar to that which has thriven in consequence of the former. The plant pathologist, however, as his name implies, claims rather to be a student than a healer of disease. As fruit of his labors what is called preventive medicine in one profession has been developed in two very remarkable ways. The practise of sterilizing seed before sowing it has now become universal among intelligent and industrious farmers. By this simple means, great shrinkage in crop is measurably prevented. If sterilized seed is used, only subsequent infection can make trouble of microbic origin. Without yet understanding the basis of immunity, the United States Department of Agriculture and the State Agricultural Experiment Stations have succeeded in developing disease-resistant varieties of plants some of which are remarkably successful. We have, in these plants, instances of actually improved races, not merely "fancy" stock; stock capable of resisting specific forms of disease. Here is eugenics of

a sort worth while, a high ideal which is attainable, and an ideal which has been attained in certain instances.

By the labors, therefore, of plant pathologists, insect enemies are attacked and at least held in check, fungous and bacterial diseases are combated; indeed, to use a current expression of painful association, they are taxed "at the source" and often, like others, taxed out of existence. By these means crop production is increased and insured without increased acreage.

The relations of the plant pathologist and the public should be similar to those of physicians and the public. The plant pathologist owes it to the public to secure the best possible training before beginning practise, training which shall include a knowledge of disease of animal as well as vegetable origin, a knowledge of normal as well as morbid physiology. By combining entomology and botany the young man may assure himself both of more certain and better employment as plant pathologist, with corresponding increase in income, and also of greater usefulness, than if he devote himself from the beginning of his training exclusively to the study of insects or of plants.

The attitude of the public to the plant pathologist, on the other hand, is curiously different from its attitude toward the physician or surgeon whose care is human or other animal ills. The physician of good training and ability, with capital enough to escape starvation for a year or two, who settles where there are enough people may count on building up a private practise sufficient for comfortable support. The plant pathologist settling in a farming community and hanging out his shingle like doctor, dentist or veterinarian, would scarcely have a call. In relation to him the public is entirely socialistic. It expects him, if he is worth while, to be employed by the state; it is satisfied to have him so paid that only the missionary spirit or limited ambition and ability will take him into the profession; it is content with cheap advice even where so important a thing as crop, income, food even, is concerned. If it were not for interest in science, interest in out-of-doors, and for the missionary spirit, the public would not have received better advice in its struggles with plant disease than it paid for. The only part of the public which pays properly in times of trouble, when a plant doctor is needed, is the corporations causing the trouble!

We see, then, that the farmer must contend with enemies of many sorts, that he and his are subject to certain inconveniences incidental to delayed returns; but we see too that his career is not only useful, with the satisfactions of usefulness, it is self-supporting. If we wish to continue our parasitic existence in the present degree of comfort, we must encourage self support in others.

THE REINCARNATION OF JAMES EIGHTS, ANTARCTIC EXPLORER

By Dr. JOHN M. CLARKE
STATE MUSEUM, ALBANY, N. Y.

IN the early days of the last century, when geography was yet young and there still remained some undiscovered nooks of the earth, the inquisitive merchant marine of our still younger and very saucy Yankee republic was finding its way into the farthest ports of the Seven Seas. The sails of the Ship of State had bellied with pride in the achievements of our canvas navy of 1812–1814, and the confident commercial enterprise which followed gave birth to a generation of agile shipmasters who recked as little of the terrors of the sea as does to-day the commander of the mightiest of our steel ocean machines. In these days before steam, the skippers of Stonington, New Bedford, New London—whalers in fact, but explorers in essence—became the pathfinders of the waters; searching their quarry in the Atlantic and Pacific, from the Arctic to the Antarctic. They never held back from cruising unknown waters in the hope of finding some new thing, and in some of these New England shipmasters grew up a fine sense of devotion to their country's credit. They sought out knowledge of foreign parts that their country might have the name and fame of discovery, and many a little brig with its stars and stripes roamed among the islands of the South Sea and into ports of the Orient, where to-day and long since the American colors are as rare as leviathans.

Edmund Fanning was one of these early Yankee venturers and one of the few who has left an account of his "seventy voyages" about the world in the years of his active life from 1792 to 1832. Fanning early became a shipmaster of the first class and, successful at that, as time passed he was a patron and promoter of voyages. America was the country of his adoption, and having adopted her he had pride in her progress and confidence in her future. If the young nation were to play her part with dignity she must do her share in the exploration of the unknown world, and, possessed of this theme, he had sufficient influence on the Congress to convince it of its duty to send out an exploring expedition over the southern seas, for down in those Antarctic latitudes where the American sealers were already finding rich fields were the mysterious Auroras, the mythical isles east of the Horn, of which returning vessels had brought enamouring tales.

So the Congress of 1812 decided upon a first official voyage of discovery into waters out of our control, and Fanning was commissioned

by President Madison commander of the two brigs *Volunteer* and *Hope*. The banner of hope was at the peak for a little while, but the same Congress soon pulled it down with a proclamation of war against Great Britain. Sixteen more years Fanning plied Congress with his project before it would again give heed to his plans for such a voyage of discovery, and in 1829 the shipmaster had grown too old to go to sea again; but early that year the United States Senate reported in favor of a South Sea expedition, and, though providing no money, it gave a moral support to the proposition and Captain Fanning was informally designated as "agent" of this first semi- or quasi-official "Voyage of Discovery." Fanning, filled with patriotic zeal, at once put two brigs into commission, the whalers and sealers, *Annawan,* Nathaniel B. Palmer, captain, and the *Seraph,* Benjamin Pendleton, captain and commander. These vessels sailed from Connecticut ports for the South Seas in October, 1829. On their return a report of the expedition made by Commander Pendleton to the "agent," Fanning, was transmitted to Congress and was published by its order. It is needless to add that such sentimental support "buttered no parsnips," so that the guarantors of the expedition had to seek their returns in seal oil and skins. More and worse than that, the commander in his report poured forth a tale of lamentations over what he thought was the failure of the expedition, excused its seeming shortcomings by stories of disease, dissension and almost mutiny among his crews, and it is hard to believe that Congress could find anything in such a calamitous tale to be worth printing at the public expense.

This is my introduction to the forgotten story of the brief scientific career of James Eights, of Albany.

It is an odd name, that of Eights, and it seems to be entirely extinct to-day in the region that knew it best. There is a tradition (perhaps nothing more) that the name was originally Van der Achten, which translated means *of more than one eight,* in other words, *Eights.* This seems rather far fetched and the name as it appears in the records of the Dutch families of Manhattan is Eght or Echt. It was not at all the practise of the Hudson valley Dutch to translate their surnames, after the manner of the French Canadians in America; but, at all events, the family stock was from Holland several generations before the birth of the scion whose name we desire to rescue from oblivion.

James Eights was the son of Dr. Jonathan Eights, in his day a well-known physician in Albany, and Jonathan was the son of Abraham, whose obvious piety won for him among his town folk the sobriquet of "Father" Eights. The specified qualities of sire and grandsire seem not to have descended far. James was born in Albany in 1798 in his father's fine Dutch house, which stood at the corner of North Pearl and Columbia streets, just opposite what is now the Kenmore Hotel, in the heart of the city's business district. A century ago this was the

center of old Dutch residence. Thereabouts were the Douws, the Terwilligers, the Huns, the Van Schaicks and Van Vechtens, the Ten Broecks and Ten Eycks, the Zerbrugges and the widow Visscher, and it was among the streets of the old town, still lined with its picturesque high-peaked houses, that young Eights got strong impressions of his environment. I say this because, if there is any memory of Eights in the town of his birth, it is of him as the artist who drew a series of color sketches of the streets of old "Albany in 1805"—pictures which have been copied so often that some of them are quite likely to be found in the homes of most of the old families. This skill with pencil and brush Eights developed very early and I am assured by one of his contemporaries, Mr. Albert Lawtenslager, now a man ninety-four years old, that these pictures were made while Eights was still a lad, though the very early date "1805" implies a memory or a tradition of houses and streets.[1]

I must say here that the records of the whole long life of James Eights are so particularly fragmentary that a diligent search has resulted in a mere matter of shreds and patches. Obviously the young man was possessed by a strong love of nature. How he indulged and promoted it we do not know, but may believe that, with the books he could get and the help he could draw from others, he was his own guide

[1] As a literary curiosity evincing a treacherous poetic license in dealing with prosaic facts of history, the inquisitive reader may be interested in a prettily written account of "Albany Fifty Years Ago" which appeared anonymously in *Harper's Magazine* for 1857 (Vol. XIV.), abundantly illustrated with woodcuts of the streets of Old Albany and with word pictures of its residents. These woodcuts were all copies of the sketches made long before by Eights, though no reference is made to the fact. It is not a very honest story for the anonymous writer begins it: "I am an Albany Knickerbocker—a Dutchman of the purest Belgic stock"—and he was nothing of the sort—and then he describes himself as a silver-haired man of eighty not many years away from his queue and cocked hat; while he was actually in his sunny forties and had little if any knowledge of the scenes he represented. Looking under the woodcuts one sees the imprint "Lossing and Barritt" and looking again into the list of authors of such unsigned articles published some years later, finds this author's name—Benson J. Lossing. The distinguished historian and engraver was not a citizen of Albany, not a Knickerbocker, but a Quaker with a little Holland blood, and he should at least have given credit to Eights for his attractive pictures. But Eights was pillaged all his life and that is one reason why he got "lost." So Lossing's stories of the old residents and their homes in 1805 must have been, in large measure, hearsay, and he seems to have got rather mixed about the Eights family for he assigns a high gabled house up North Pearl street a few doors beyond "Webster's Corner" (State and Pearl) to William Eights who is said by him to have been driven from New York in 1776, after the British occupation, because of his Whig sentiments. There never was but one Eights family in Albany and the head of it then was Abraham Eights. He doubtless came from New York and he may perhaps have lived in this house, but if he did his son, Dr. Jonathan, built the house we have referred to far up the street near the Fox Kill.

and master in his study of the rocks, the plants and the animals about his home, in all of which we know he was deeply interested. What he had of the schools seems to have been only from those of his own town, but when he came to the time of fixing his career in life, he naturally turned to medicine; it was his father's, it should be his, and it afforded a better chance of close touch with natural history than any other. And so perhaps for this reason James Eights became a physician.

He was to be now known through life as Doctor Eights, but he seems never to have practised medicine. It is here, along through the years of his young manhood, that there is neither record nor story, and it is not till the event of the Fanning voyage that this unwilling escupalian cut the first and almost only notch in the tally stick of his real career. Through influences we do not know but which were a testimony of his recognized ability in natural history, he was appointed naturalist to the "Exploring Expedition of 1830," that first United States voyage of discovery. There is not a word in any record left by him or his shipmates that indicates whether he sailed on the *Seraph* or the *Annawan*, but the two brigs seem to have kept together and shared their troubles. Indeed, so far as I can find, his name was never mentioned in any record as a member of this scientific company by any one except Captain Fanning and Eights himself.

As I write now of Doctor Eights's admission to quasi-official scientific service on this cruise of discovery, I call to mind the characterization of the man by my chief and Eights's contemporary, Professor James Hall, the distinguished geologist of New York from 1836 to 1898, who frequently spoke to me of his high regard for Eights's extraordinary scientific talents. He must have had a very close touch with all the natural science of his day, however he got it, for this is evident in the technical reports of his explorations and his subsequent writings.

Congress had "approved" this expedition in June, 1829, and the two brigs left New London in October, headed straight for the Antarctic, but with orders to meet at Staaten Island in case they got separated on the way. Directly they left the home port they did lose each other, and neither saw its consort till the distant island was reached. Staaten Island lies at 55° just off the east point of Fuego. It is an island that has figured often in the experiences of the explorers, for, barren spot as it is, it lay on the Cape Horn course and was a point of departure for the short and sharp attack on the seals of the Antarctic ice front. Thence one of the boats, probably the *Annawan*, but perhaps both, put out for the South Shetland Islands—those remote spots of whose enormous supply of seals abundant evidence had come by the American whaling fleet and had beyond doubt helped to substantiate this expedition. Now in this year 1829 what was known of these South Shetland Islands is the following:

Students of southern explorations seem to have little doubt that the

first to see them was Dirck Gerritse, whose good ship *De Blyde Boodschap* in 1599 was driven by a gale far to the south of Magellan when her captain sighted in the distance the tops of some snow-clad mountains. In itself this record was of much the same worth as the discovery of "Crocker-land." It is as equally certain that the first trustworthy knowledge of them came from the American sealers and whalers who had found them out as early as 1812. For years these American ships resorted thither, but no record of the new lands was laid down till the English skipper, Captain William Smith, observed them in 1819, made them out to be a chain of islands and called them the *New South Shetlands.* Fanning whimsically says:

> We Yankees might with more propriety after our rediscovery, claim them and name them *South Martha's Vineyard,* or something else.

Smith returned to Valparaiso, told his story to Captain Sheriff of the British frigate *Andromache,* and Sheriff detailed Lieutenant Bransfield to accompany Smith back to the islands, and they two are said to have determined the extent of the group. Gerritse, Smith and Bransfield all have their names perpetuated in the geography of the region—Dirck Gerritse Archipelago, Smith Island and Bransfield Strait. Fifteen months later came the Yankee brig *Hersilia,* Captain J. B. Sheffield, Nathaniel B. Palmer, mate, and they gave names to the individual islands from west eastward, but these have been ignored for the names of to-day.

Thus when the Yankee brig of 1829 with its scientific supercargo, Eights, aboard, picked up the islands only so little as has been indicated was known of them, and all that has been written since will barely enlarge our knowledge of them beyond that given by Dr. Eights in his *Remarks on the New South Shetland Islands,* communicated to the Albany Institute in 1833.[2] There is in this descriptive account a pleasing diction, and an effective phrasing, tinged by a kind of Wordsworthian

[2] *Transactions of the Albany Institute,* Vol. 2, p. 58. The full title is: "Description of a new Crustaceous Animal found on the Shores of the South Shetland Islands, with Remarks on their Natural History. By James Eights, Naturalist to the Exploring Expedition of 1830, and Corresponding Member of the Albany Institute."

The "Antarctic Manual," prepared for the use of the National Antarctic Expedition in 1901, by George Murray, with preface by Sir Clements Markham, contains a supposedly complete bibliography of the Antarctic, but there is, in a list of 878 titles, no single reference to Eights's papers nor to the expedition to which he was attached; neither to the *Annawan* or *Seraph,* the *Hersilia* or Sheffield, Captain N. B. Palmer, discoverer of Palmer's land in 1820, is confused with J. C. Palmer, whose title to fame seems to lie in a mariner's song written by him in 1868; Titian Peale, of the Wilkes Expedition, is called Titus Peale, and so on. Contemporary reviewers in American scientific and literary magazines ignored Eights entirely though steeping their pages with the work of other explorers (*vide, e. g., Silliman's Journal, Knickerbocker Magazine, North American Review*).

color, which clothes the rawness of the subject, quite too obviously exposed in the accounts of later writers. His sentences are worth reading, and in the light of new knowledge it is to be remembered that his descriptions, ignored by time, were written eighty-six years ago. To establish Eights in his true estate it is well to extract freely from his accounts of these islands.

Speaking generally of their physiography, he says:

> They are formed by an extensive cluster of rocks rising abruptly from the ocean, to a considerable height above its surface. Their true elevation can not easily be determined, in consequence of the heavy masses of snow which lie over them, concealing them almost entirely from the sight. Some of them, however, rear their glistening summits to an altitude of about three thousand feet, and when the heavens are free from clouds, imprint a sharp and well-defined outline upon the intense blueness of the sky: they are divided everywhere by straits and indented by deep bays, or coves, many of which afford to vessels a comfortable shelter from the rude gales to which these high latitudes are so subject. When the winds have ceased to blow and the ocean is at rest, nothing can exceed the beautiful clearness of the atmosphere in these elevated regions. The numerous furrows and ravines which everywhere impress the snowy acclivity of the hills are distinctly visible for fifty or sixty miles, and the various sea-fowl, resting upon the slight eminences and brought in strong relief against the sky, ofttimes deceive the experienced eye of the mariner by having their puny dimensions magnified in size to those of the human form.
>
> The sun, even at midsummer, attains but a moderate altitude in these dreary regions, and when its horizontal beams illumine these masses of ice, their numerous angles and indentions catching the light as they move along, exhibit all the beautiful gradations of color from an emerald green to that of the finest blue. Some of them whose sloping sides will admit of their ascent, are tenanted by large assemblages of penguins, whose chattering noise may be heard on a still day at an incredible distance over the clear smooth surface of the sea. When the storms rage and the ocean rolls its mountain wave against their slippery sides, the scene is truly sublime. Tall columns of spray shooting up far above their tops, soon become dissipated in clouds of misty white; gradually descending, they envelope the whole mass for a short space of time, giving to it much the appearance of being covered with a veil of silvery gauze. When thus agitated they not unfrequently explode with the noise of thunder, scattering their fragments far and wide over the surrounding surface of the deep.
>
> The sky too in these latitudes presents a very singular aspect; being most generally filled with innumerable clouds, torn into ragged and irregular patches by the wild gales which everywhere race over the Antarctic seas; the sun as it rises or sets, slowly and obliquely in the southern horizon, sends its rays through the many openings between, tingeing them here and there with every variety of hue and color, from whence they are thrown in mild and and beautiful reflections upon the extensive fields of snow which lie piled on the surrounding hills, giving to the whole scene for a greater part of the long summer day, the ever varying effect of a most gorgeous sunset.

This is certainly a toothsome and pictorial dressing for the bare bones of the Antarctic, which challenges only an artist's palette.

It is worth while taking note of Eights's geological observations. The reader should bear in mind that they were the first ever made in

the Antarctic and were put down by a man who was in his time reckoned a geologist.

The geological features that these islands present in those highly favored situations, where the continuous power of the winds has swept bare the rocks, correspond in a great measure with their desolate and dreary aspect. They are composed principally of vertical columns of basalt, resting upon strata of argillaceous conglomerate; the pillars are united in detached groups, having at their bases sloping banks constructed of materials which are constantly accumulating by fragments from above. These groups rise abruptly from the irregularly elevated plains, over whose surface they are scattered here and there, presenting an appearance to the eye not unlike some old castle crumbling into ruin, and when situated upon the sandstone promontories that occasionally jut out into the sea, they tower aloft in solitary grandeur over its foaming waves; sometimes they may be seen piercing the superincumbent snow, powerfully contrasting their deep murky hues with its spotless purity. Ponds of fresh water are now and then found on the plains, but they do not owe their origin to springs, being formed by the melting of the snow. . . .

A few rounded pieces of granite are occasionally to be seen lying about, brought unquestionably by the icebergs from their parent hills on some far more southern land, as we saw no rocks of this nature *in situ* on these islands. In one instance, I obtained a boulder nearly a foot in diameter from one of these floating hills. The action of the waves has produced little or no effect upon the basalt along this coast, as its angles retain all the acuteness of a recent fracture, but when the conglomerate predominates, the mass is generally rounded.

The color of the basalt is generally of a greenish black. The prisms are from four to nine sided, most commonly however of but six, and from three to four feet in diameter; their greatest length in an upright position above the subjacent conglomerate is about eighty feet. Their external surfaces are closely applied to each other, though but slightly united, consequently they are continually falling out by the extensive power of the congealing water among its fissures.

Clusters of these columns are occasionally seen reposing on their side in such a manner as to exhibit the surfaces of their base distinctly, which is rough and vesicular. When this is the case they are generally bent, forming quite an arch with the horizon. When they approach the conglomerate for ten or twelve feet, they lose their columnar structure and assume the appearance of a dark-colored flinty slate, breaking readily into irregular rhombic fragments; this fine variety in descending, gradually changes to a greenish color and a much coarser structure, until it passes into a most perfect amygdaloid, the cavities being chiefly filled with quartz, amethyst and chalcedony. . . . The effect produced upon it by the action of the file is very slight; the steel elicits no sparks; the fragments are angular with an imperfect conchoidal fracture; its structure is coarsely granular and uneven, and is composed essentially of hornblende, feldspar and a greenish substance in grains much resembling epidote; crystals of leucite of a yellow and reddish tinge are disseminated throughout the mass whose fractured surfaces strongly reflect the rays of light to the eye; in some places it sensibly affects the needle, owing no doubt to its iron. Veins of quartz frequently traverse the fine variety, some of them containing beautiful amethysts.

The basis rock of these islands, as far as I could discover, is the conglomerate which underlies the basalt. It is composed most generally of two or three layers, about five feet in thickness each, resting one on the other and dipping to the southeast at an angle of from twelve to twenty degrees. These layers are di-

vided by regular fissures into large rhombic tables, many of which appear to have recently fallen out, and now lie scattered all over the sloping sides of the hills, so that the strata when seen cropping out from beneath the basalt present a slightly arched row of angular projections of some considerable magnitude and extent.

The upper portion of this conglomerate for a few feet is of a dirty green color, and appears to be constructed by the passage of the amygdaloid into this rock, the greenish fragments predominating, and they are united to each other principally by zeolite of a beautiful light red, or orange color, together with some quartz and chalcedony.

The minerals embraced in this rock are generally confined to its upper part, where it unites and passes into the incumbent amygdaloid; many of them are also in common with that rock. They consist chiefly of quartz, crystalline and amorphous, amethyst, chalcedony, cachalong, agate, red jasper, felspar, zeolite, calcareous spar in rhombic crystals, sulphate of barytes, a minute crystal resembling black spinelle, sulphuret of iron and green carbonate of copper.

The only appearance of an organized remain that I anywhere saw was a fragment of carbonized wood imbedded in this conglomerate. It was in a vertical position, about two and a half feet in length and four inches in diameter: its color is black, exhibiting a fine ligneous structure, the concentric circles are distinctly visible on its superior end, it occasionally gives sparks with steel, and effervesces slightly in nitric acid.

In this very detailed account of the columnar basalts with the sandstone conglomerate into which they are intruded, and the metamorphism of the contact zone, Eights first laid hold of structures which have been recorded again by later observers. The sandstones seem to be the same as that called by Ferrar of the *Discovery* the "Beacon sandstone" which with its volcanic sills covers great areas of South Victoria Land. Debenham of the Scott Expedition has written of them. In 1892 Larsen at Seymour Island just east of Graham Land, found fossils, the first, says Nordenskiold and after him Amundsen, winner of the South Pole, ever taken in the Antarctic. But here was Eights more than 60 years before, knocking out fossil wood from the sandstones of the South Shetlands—wood which, in more than remote probability, pointed toward that mysterious Gondwana Land which has been thought to have bound Antarctic America to the Orient during the most of its geological history. Shackelton found seams of coal and fossil wood in this Beacon sandstone, of which Schetelig says, "this belongs to the Upper Devonian or Lower Carboniferous." Now with the richness of fossil life recently brought home by Andersson and Nordenskiold, Amundsen, Shackelton and the men of Scott, let us acknowledge the keen-eyed record and the intelligent interpretations of the Albany naturalist.

Eights was among the first observers to make record of the active volcanoes in the vicinity of these islands, and what was then called Palmer's Land—the land, which passing down the years with various designations, has slipped first its American hawser and then its French (Louis Philippe Land), to tie up at last with an Englishman, Graham.

He saw and took note of that remarkable half-submerged crater, Deception Island, soon to be much more fully described by the Englishman, Foster, a year or two later.

To the botanical species listed by Eights as composing the flora of these islands, later years may have brought some additions. Of this I can not be sure, but he says:

> The *Usnea fasciata* Torrey is most common. A species of *Polytrichum* resembling the *alpinum* of Lin., one or two lichens and a fucus found in the sea along the shores—when you add to these an occasional plant of a small species of *avena*, you complete the botanical catalogue of the islands.

Then, in his picturesque way, Eights takes up for description the water mammals, the sea-elephant (*Phoca leonina;* I am using his designations), the sea-leopard, the fur seal (*P. vitulina*).

> There is also a fourth species, which I have no recollection of ever seeing the slightest notice of. It is probably not common, as I saw but one; it was standing on the extremities of its fore-feet (flippers), the head and chest perfectly erect, abdomen curved and resting on the ground, the tail was also in an upright position; the animal in this attitude bore a striking resemblance to the representations we frequently meet with of the "mermaid," and I think it was undoubtedly one of the animals of this genus that first gave origin to the fable of the maid of the sea. I regret that I could not obtain a nearer view of this interesting animal. When I approached within one hundred feet, it threw itself flat and made rapidly for the sea: it appeared about twelve or fifteen feet in length, and distinctly more slender in proportion than any of the other species, so much so that the motion of the body when moving seemed perfectly undulating. Some of the seamen had seen them frequently on a former voyage, and mentioned that they were known among sealers by the name of sea-serpent, from this circumstance. Some of the teeth were brought to me which had been picked up on the beach. The crown of the grinders is deeply and singularly five lobed.
>
> When these [other] animals resort to the shores for the purpose of breeding or shedding their hair, they are in fine condition. During this time they require no food, existing by the absorption of their fatty matter: if killed at this period, you generally find a quantity of small stones in the stomach, swallowed most probably for the purpose of keeping that organ distended and preventing its internal surfaces from adhering to each other. When the season for returning to the sea arrives, these stones are ejected on the beach, and they proceed in search of their ordinary food, which is chiefly penguins. A singular character in the habit of these animals is the faculty they possess of shedding tears when in any way molested. The eyes becoming suffused and the large tear-drops chasing each other in quick succession over their wrinkled faces, creates quite a sympathy in the breast of the beholder.

He also describes the fin whale (*Balæna physalis*), right whale (*B. mysticus*), the grampus, dolphin and porpoise—perhaps a fairly complete statement of this fauna as now known, though they are now traveling under somewhat different names.

In present days great interest has attached to the birds of these latitudes, and pretty tales of the whimsical Antarctic penguins have been the delight of several recent writers. Let us see what Eights had to say of them in 1830:

The *Aptenodytes patagonica*, Gm. (king penguin) is the largest and by far the most beautiful of the species, and may be seen in great numbers covering the shores for some considerable extent. They are remarkably clean in their appearance, not a speck of any kind is suffered for a moment to sully the pure whiteness of the principal part of their plumage: their upright position, uniform cleanliness, and beautiful golden yellow cravat, contrasts finely with the dark background by which they are relieved, so that the similitude is no unapt one, which compares them to a regiment of soldiers immediately after parade. The females lay but one egg on the bare ground, which is rather larger than that of a goose, and of about equal value as an article of food, but differs a little in shape, being more tapering at its smaller end. The egg lies between the feet, the tail being sufficiently long to conceal it effectually from the sight. When approached they move from you with a waddling gait, rolling it along over the smooth surface of the ground, so that a person not acquainted with the fact might pass through hundreds of them without discovering it. The *Spheniscus antarcticus* Shaw (rookery penguin), is more numerous than any of the other species, assembling together in vast congregations, occupying the smooth strips of plain for a mile or more in extent; passing through them, they barely give you sufficient space, picking at your legs, and keeping up a continual chatter. Their whole appearance as you walk along brings powerfully to your recollection the story of Gulliver, striding among the Lilliputians.

Sixteen other species of birds are mentioned by him in their Latin dress. And then, first again in this field, he mentions the Mollusca—three species, a *Pholas*, a *Nucula* and a *Patella*, all new to science, he thought.

This account of the South Shetlands was perhaps Dr. Eights's most notable contribution to science, but it was rather general and did not represent the total outcome of his investigations. In connection with it, in the *Transactions of the Albany Institute*, he described[3] under the name *Brongniartia trilobitoides* a crustacean of which he says:

I was convinced that [it] came nearer to the long lost family of Trilobites than anything hitherto discovered.

Amos Eaton, the distinguished teacher and Eights's friend, had the same conviction, for he says of this creature[4] when describing the trilobite genus *Brongniartia* (a name of his own contrivance):

It is my opinion that Dr. Eights has specimens of two distinct species of this genus which he collected in the southern ocean.

Eights thought that the species of Eaton's genus belonged to genera already employed by Jacob Green and DeKay, and so in the mutual scramble to honor Alexander Brongniart, he appropriated the word *Brongniartia* for his "living trilobite." Eights's drawings of his crustacean are beautifully effective and detailed and to aid in its illumination he adds a picture of the Silurian trilobite *Lichas Boltoni*. The living trilobite waited seventy years for rediscovery. Mr. Hodgson, reporting

[3] As cited above.

[4] "Geological Textbook," 2d ed., 1832.

for the "Discovery" Expedition, describes and figures it under the name of *Serolis trilobitoides*.

In another paper, a year or two later, but printed in the same volume of the Albany Institute's *Transactions*, Eights describes another strange crustacean,[5] illuminated by two exquisite plates. This is his *Glyptonotus antarctica*, an isopod-looking creature, of which its finder, still impressed by his acquaintance with New York State fossils, remarks:

> This beautiful crustacean furnishes to us another close approximation to the long-lost family of the Trilobite.

Doctor Chilton of Christchurch, New Zealand, informs me that this crustacean was found by the German Transit of Venus Expedition to South Georgia in 1882–3 and was redescribed by Pfeffer in 1887. "It does not," he says, "seem to have been collected by the more recent English, French and German Antarctic expeditions." Doctor Chilton thinks that the species is among the specimens brought home by the Scottish Antarctic Expedition.

Still a third paper with other fine drawings was published by him in 1837 in the first volume of the *Journal of the Boston Society of Natural History*,[6] and gave an account of *Decolopoda australis*, an unbelievable ten-legged pycnogonid, the first thing of its kind. Dr. Leon J. Cole, writing to me from Cambridge some years ago, says of this:

> A ten-legged pycnogonid such as *Decolopoda* was an unheard of thing until Eights described this one, and for some reason his discovery appears never to have come to the attention of students of the group, for nowhere, so far as I have been able to find in the writings since his paper was published, has mention been made of the remarkable fact. When I looked up Eights's paper a year or two ago I thought at first that a mistake had been made in the drawing and one too many pairs of legs put on the animal. . . . I was not so much surprised as I should otherwise have been when a paper appeared this winter (1905) by Mr. J. V. Hodgson, naturalist on the *Discovery*, describing a ten-legged pycnogonid taken by the National Antarctic Expedition in McMurdo Bay, the ship's winter quarters. Mr. Hodgson named his form *Pentanymphon* and says that the presence of a fifth pair of legs is a "character which separates it from all the Pycnogonids hitherto known." . . . I then wrote to Mr. Hodgson calling his attention to Eights's paper, which it appears had been brought to his notice in the meantime, and in reply he informs me that among the Pycnogonida collected by the Scottish Antarctic Expedition he has found specimens which agree in all essentials with those described so long ago by Eights.

A more recent letter from Dr. Cole from Madison (1915) says that the Scottish Expedition found fifteen specimens of Eights's species in Scotia Bay, South Orkneys, and the French Expedition another species of this genus.

[5] "Of a New Animal Belonging to the Crustacea Discovered in the Antarctic Sea."

[6] "Description of a New Animal Belonging to the Arachnides of Latreille; Discovered in the Sea along the Shores of the New South Shetland Islands," p. 203.

The "Voyage of Discovery" and its results were after all a matter of no slender record, and Eights's hours seem now to have become of rather idle and impecunious ease. In the years from 1835 to 1840 he wrote anonymously for the *Zodiac*, an Albany magazine of distinctly cultural pretension, articles on the flowers, clouds, weather, insects, birds, mollusca, geology, the lowering of the Hudson River, elevated beaches, turtles, sun-spots, fossils, minerals, constellations, all local observations of a well-stocked mind belonging to an out-of-doors man and naturalist. Somewhere about this time or earlier he must have invented the name "Cocktail" or "Cauda-galli grit" for one of the New York geological formations. It was a name that came into general use and was ascribed to Eights by the official geologists of the state who adopted and continued to use it till it was displaced by the present substitute, "Esopus grit."

But during these years other things were brewing in the line of exploring expeditions. On the Fanning expedition with Eights, as a member of the scientific corps, had been John N. Reynolds. Reynolds was not a man of science, but a landsman from the Middle West to whom the ancient call of the sea was invincible. Of him and his associates Captain Fanning says, in writing to the Secretary of the Navy, Mahlon Dickerson (1836):

> Mr. Reynolds having been one of the individuals in the little American Exploring Expedition (the first patronized by government) of the brigs *Seraph* and *Annawan*, etc., . . . two of the gentlemen companions of the voyage, Messrs. John Frampton Watson, of Philadelphia, and James Eights, of Albany. These are profound scientific men.

To Reynolds has been given the credit of initiating the sentiment and leading the campaign which resulted in the organization of the Wilkes Exploring Expedition. "The father of this project was John N. Reynolds," said President Gilman in his "Life of James Dwight Dana," and at some length he refers to Reynolds's vigorous propaganda on its behalf, both before and outside of Congress. But, says Secretary Dickerson to Captain Thomas Ap Catesby Jones (who had been first selected to command the proposed expedition) in a letter of 1836:

> Captain Fanning long since proposed a South Sea exploring expedition and has been urging it ever since. Ever since the administration of Mr. Madison, so far as there is merit in originating and urging, this measure is due to Captain Fanning.

On this new expedition Eights wanted to go, and his experience was beyond doubt reasonable guaranty of his fitness. And as the plans grew, he filed with the Secretary of the Navy his application for appointment as *geologist*. Besides his experience afloat and ashore, he had the endorsement of Professor John Torrey, the eminent botanist, and doubtless of Captain Fanning, and he was duly appointed by Secretary

Dickerson, of which appointment he makes acknowledgment in June, 1837. Then, two months after, the appointees of the scientific corps got together in Philadelphia and fixed up their assignments. Reynolds, who was most active in organizing the supercargo, did not want Eights at all; Torrey had written to Dickerson that he never intended to recommend Eights as geologist; he and all the rest wanted Dana for mineralogist and geologist and Eights for zoologist, and when the men themselves met to determine their assignments (this was left by the Secretary to their own discretion) Eights withdrew his choice and contented himself with the field of "organic remains." Eights's appointment was notified to Congress by the Secretary, he was permitted to buy his equipment including $300 worth of books, and he received pay in advance of sailing until the appropriation was exhausted. But nevertheless, for reasons which appear on no records that I have been able to find or that have ever been referred to, Eights was omitted in the final make-up of the corps of scientific men. He was not alone in this mishap and others who suffered with him joined later in an appeal to Congress for remuneration for wasted time and service.

What brought about this elimination of Eights from the Wilkes Expedition there is none left to tell. To have had his functions restricted by his colleagues to that of paleontologist of a marine expedition seems a reduction to the lowest terms, dangerously close to an elimination, which lay beyond their power. And yet Dana, for whom Eights allowed himself to be effaced, went as "mineralogist" and came back as a zoologist of high distinction. Perhaps Eights, with his experience and versatility, might have done as well, but the American Philosophical Society, in responding to a request of the Secretary of the Navy for a plan of organization of the scientific corps, did not include a paleontologist, and we have just observed that Mr. Reynolds, who was clothed with no small authority in this matter of composing the personnel of the corps, did not approach or recommend Eights. Wherever the cause lay, in disaffection acquired by Reynolds for Eights while on their trip to the Antarctic, in the thinly veiled jealousies common to scientific men of the time,[7] or perhaps in Eights's personal habits, this crushing of his hopes was the downfall of his career. Whatever justification the Secretary of the Navy may have found for his final action in the case, Eights from this time on ceased to live; though he remained on earth for nearly a half century longer.

The rest of the story is short. There are no records of Albany that

[7] As a notable example of the bumptious democracy of the time, the series of anonymous letters publicly addressed by J. N. Reynolds to Secretary Dickerson on the subject of the expedition, are hardly to be surpassed for personal indelicacy, disrespect for high place and rudeness of address, and they were assembled and printed by their author over his own name.

tell of Eights's activities during the years that followed. Only the directories show his occasional presence up to 1853. In his contributions to the *Zodiac* there are passages which show a rather intimate acquaintance with Indian customs and life, and Mr. Lawtenslager has intimated that after the sailing of Captain Wilkes, Eights did go out among the western tribes, but if under government auspices I have found no record of it. In 1853 his name appears for the last time in the Albany directory, where he is entered as "draughtsman and geologist." There is no evidence among the very full documents in my possession relating to the Geological Survey that Eights had any official connection with it, and I fancy this title means that he was doing drawing and geology for Dr. Ebenezer Emmons for his *geological* reports on the agriculture of New York. These were days when the Taconic controversy was hot and Emmons's "Taconic system" was struggling for life. Emmons was writing his full exposition of it for his "Agriculture of New York," and his colleagues during the days of the first State Geological Survey (1836–42) had vigorously antagonized the entire proposition. Ebenezer Emmons, Jr., who knew Eights as his father's friend, has told me that Eights had sympathized with and stood by the elder Emmons in these contentions and no such man could have gained employment from the New York State Geologist of 1853. In 1852 Eights published a paper in the *Transactions of the Albany Institute* on the surficial geology of Albany.[9] It contains much that is interesting even to-day regarding the composition and hydrology of the sands and clays of old Lake Albany and gives one of the earliest illustrations of the disrupted clay strata broken into by dragging icebergs.

This is Dr. Eights's last appearance, and of what remained of his life little is to be said further, or little known, and even that is hardly worth the telling. Mr. Lawtenslager, who came to Albany in 1848 and started in business on State Street just below Green, tells me that in the 50's he and Eights had rooms together there. Eights was unmarried and alone, and he was poor—so poor, indeed, that it is clear to me from the very guarded statements of his old companion, that the friendship of the two meant subsistence for one. I have heard, too, of another great disappointment in his life—one that turned his heart sour and kept him a bachelor. So his sands ran on—he had lost his grip—through the sixties and into the seventies; he was an old man now and in his growing feebleness he sought the home of a sister living in Ballston, and there died in 1882, eighty-four years old.

James Eights left his mark—and now let us judge of the size of Hercules from his foot.

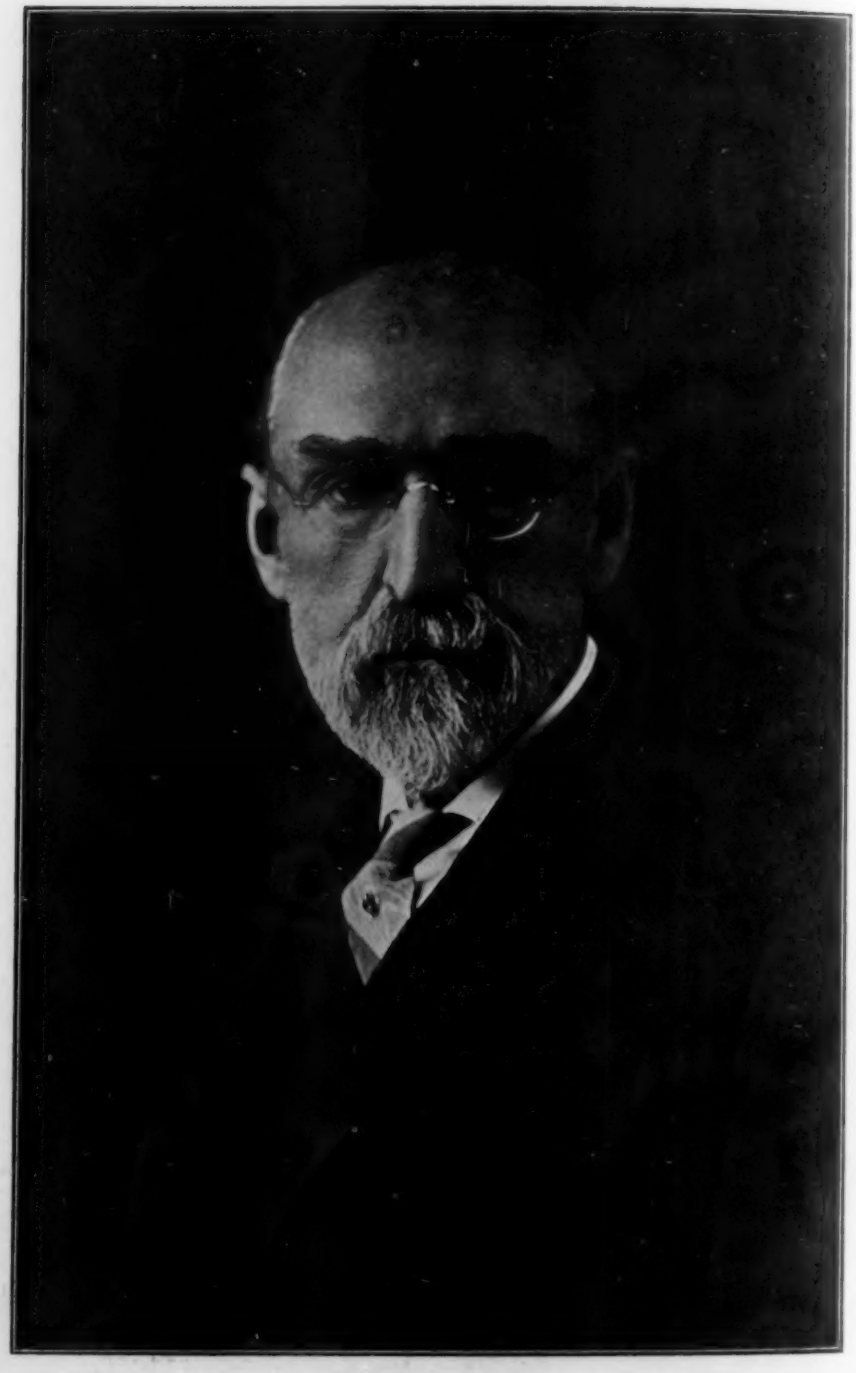
[9] "Observations on the Geological Features of the Post Tertiary Formation of the City of Albany and Its Vicinity" (Vol. 2).

THE PROGRESS OF SCIENCE

THE COLUMBUS MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

ALTHOUGH there was this year a wide dispersal of scientific societies with some conflict in their meetings, the scientific men of the country have become so numerous that it is possible to conduct a number of simultaneous meetings, each of which has a larger attendance and a more important program than would have been possible for all the scientific interests of the country to arrange twenty-five or thirty years ago. Thus the attendance at Columbus was in the neighborhood of one thousand. At the Pan-American Scientific Congress in Washington the attendance was about the same, although there the natural and exact sciences did not dominate the program or the situation. In Boston, however, there was an excellent meeting of physiologists and men working in related lines with a program of some three hundred papers. The anatomists at New Haven and the psychologists at Chicago also had well-attended meetings.

ON THE GROUNDS OF THE OHIO STATE UNIVERSITY. The spring with the Library in the distance.



DR. CHARLES R. VAN HISE,
President of the American Association for the Advancement of Science.

At the Ohio State University the American Association met in its twelve sections and in affiliation with some fifteen special national societies, including those devoted to mathematics, physics, zoology, entomology and botany. The opening meeting completely filled the college chapel, seating about twelve hundred persons. The address of welcome, by President W. O. Thompson, of the university, and Dr. T. C. Mendenhall, past-president of the association, were extremely happy. Dr. Thompson welcomed the association on the part of the university, city and the commonwealth, and Dr. Mendenhall, finding that his predecessor had included practically all of Ohio in his address, welcomed the association on the part of the shades of deceased Ohio men of science, sketching briefly the career of a number of Ohio's great men of science of the past century. President Eliot's address entitled "The Fruits, Prospects and Lessons of Recent Biological Science" was published in the issue of *Science* for January 7.

It points out that up to a hundred years ago the principal applications of science were of physics and chemistry, and that, while these had vast economic value, the good was mixed with evil, as in the development of the factory system and the congestion of population in cities. It was claimed that during the past hundred years, biological science has contributed most to the well-being of humanity, and that its service had been direct and entirely beneficent. Those who heard Dr. Eliot's admirable address will be inclined to agree with a remark recently made by a leading professor at Harvard that the only serious error Dr. Eliot had made in his life was retiring from the presidency of the university at the age of seventy-five.

There were three public lectures complimentary to the citizens of Columbus given by Professor Douglas W. Johnson, of Columbia University, on "Surface Features of Europe as a Factor in the War"; Dr. Raymond F. Bacon, director of the Mellon Institute of Pittsburgh, on "The Industrial Fellowships of the Mellon Institute: Five Years' Progress in a System of Industrial Service," and Dr. Frank K. Cameron, of the Bureau of Soils, Washington, on "The Fertilizer Resources of the United States." Then there were

UNIVERSITY HALL.

THE LIBRARY.

the addresses before the sections and the special societies and a large number of discussions and programs of general interest, as well as the long series of special papers in the different sections covering the research work accomplished during the year.

Dr. W. W. Campbell, director of the Lick Observatory, who presided at Columbus, gave an evening address on "The Evolution of the Stars" at a special meeting of the association called in Washington the following week as a compliment to the Pan-American Scientific Congress. As his successor in the presidency of the association, the highest honor annually conferred on an American man of science, Dr. Charles R. Van Hise, was elected. Dr. Van Hise, who as professor of geology has attained scientific eminence by his contributions to structural geology and ore-deposits, has recently been active in the plans for the conservation of natural resources, and as president of the University of Wisconsin for the past thirteen years has been the leader in the movement to make the university a dominant factor in the state.

THE OHIO STATE UNIVERSITY

THE Ohio State University is at the gateway between the Atlantic states and

THE ARCHEOLOGICAL AND HISTORICAL MUSEUM.

CHEMISTRY HALL.

the north central states. On one side the private universities and colleges predominate, on the other, state supported institutions. Two years ago, there were 129,000 students in the private institutions for higher education in the United States, while there were 88,000 in our public institutions. In the North Atlantic division there were about 60,000 students in the private institutions and 8,000 in the public institutions, whereas in the North Central division there were 41,000 in the one and 44,000 in the other. The Ohio State University, owing to its situation and to the private universities of the state, was one of the last to take its place among the great state universities. It is also the case that in Ohio there are two other state-supported universities, Ohio University and Miami University, while the University of Cincinnati is the leading city-supported institution of the country.

The Ohio Agricultural and Mechanical College was one of the land grant institutions established under an act approved by President Lincoln in 1862. It was not, however, chartered by the legislature until 1870, and was opened for the reception of students only in 1873. In 1878 the name was changed to the Ohio State University. When the American Association met in Columbus in 1899 the institution was well established, but the growth that has taken place in the intervening years is

BOTANY AND ZOOLOGY BUILDING.

OHIO UNION, THE STUDENT BUILDING.

remarkable. The old university hall, typical of the college architecture of the last generation, is now surrounded by a group of fine modern buildings and laboratories, including the library built in 1912 at a cost of $300,000 and the archeological and historical museum, opened a year later. The Ohio Union has been erected at a cost of about $100,000, as a social center for student activities, and there is a series of buildings for the different sciences, including physics, chemistry, botany and zoology, horticulture and forestry and other agricultural departments.

All the colleges and departments of a modern university are included in the organization. There are, indeed, some schools not always found, such as colleges of education, pharmacy and dentistry, and there has recently been organized a college of commerce. Apart from the summer session, attended by about 1,000 students, and the shorter courses in agriculture, there are this year 4,900 students in the university, giving it a rank in size just above the University of Wisconsin and the University of Minnesota. There are 481 professors and other officers who accomplish, apart from the teaching of the students, a large amount of research work and public service of benefit to the state and to the country.

SCIENTIFIC ITEMS

WE record with regret the death of Dr. Eugene Woldemar Hilgard, professor emeritus of agriculture in the University of California; of Dr. Arthur Williams Wright, professor emeritus of experimental physics at Yale University; of Daniel Giraud Elliot, known for his contributions to mammalogy and ornithology, and of Sir Henry Enfield Roscoe, the distinguished chemist, emeritus professor in the University of Manchester.

AT the Columbus meeting of the American Association vice-presidents were elected as follows: Mathematics, L. P. Eisenhart, Princeton University; physics, H. A. Bumstead, Yale University; engineering, E. L. Corthell, Brown University; geology and geography, R. D. Salisbury, University of Chicago; zoology, G. H. Parker, Harvard University; botany, T. J. Burrill, University of Illinois; anthropology and psychology, F. W. Hodge, Bureau of Ethnology; social and economic science, Louis I. Dublin, New York; education, L. P. Ayres, the Russell Sage Foundation; agriculture, W. H. Jordan, the New York State Experiment Station.